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Coos Bay District Bureau of Land Management
1300 Airport Way
North Bend, Oregon 97459

Siuslaw National Forest
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Corvallis OR, 97333

U.S. Fish and Wildlife Service
2127 SE OSU Drive
Newport, Oregon 97365
Recovery Permit TE-839094-4

Oregon Department of Fish and Wildlife
3406 Cherry Avenue NE
Salem, OR 97303

Oregon Department of Parks and Recreation
10965 Cape Arago Highway
Coos Bay, Oregon 97420

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Abstract

From 8 April – 27 September 2010 we monitored the distribution, abundance and productivity of the federally Threatened Western Snowy Plover (*Charadrius alexandrinus nivosus*) along the Oregon coast. From north to south, we surveyed and monitored plover activity at Sutton Beach, Siltcoos River estuary, the Dunes Overlook, North Tahkenitch Creek, Tenmile Creek, Coos Bay North Spit, Bandon Beach, New River, and Floras Lake. Our objectives for the Oregon coastal population in 2010 were to: 1) estimate the size of the adult Snowy Plover population, 2) locate plover nests, 3) continue selective use of mini-exclosures (MEs) to protect nests from predators and evaluate whether exclosure use can be reduced, 4) determine nest success, 5) determine fledging success, 6) monitor brood movements, 7) collect general observational information about predators, and 8) evaluate the effectiveness of predator management.

We observed an estimated 232-236 adult Snowy Plovers; a minimum of 175 individuals was known to have nested. The adult plover population was the highest estimate recorded since monitoring began in 1990. We monitored 261 nests in 2010, the highest number of nests since monitoring began in 1990. Overall Mayfield nest success was 25%. Exclosed nests (n = 67) had a 72% apparent nest success rate, and unexclosed nests (n = 194) had a 23% apparent nest success rate. Nest failures were attributed to unknown depredation (24%), unknown cause (17%), one-egg nests (15%), rodent depredation (14%), abandonment (12%), wind/weather (5%), corvid depredation (5%), mammalian depredation (4%), wave overwash (2%), infertility (2%), and adult depredation (1%). We monitored 94 broods, including two from unknown nests, and documented a minimum of 80 fledglings. Overall brood success was 55%, fledging success was 33%, and 0.90 fledglings per male were produced.

Continued predator management, habitat improvement and maintenance, and management of recreational activities at all sites are recommended to achieve recovery goals.

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Introduction

The Western Snowy Plover (*Charadrius alexandrinus nivosus*) breeds along the coast of the Pacific Ocean in California, Oregon, and Washington and at alkaline lakes in the interior of the western United States (Page *et al.* 1991). Loss of habitat, predation pressures, and disturbance have caused the decline of the coastal population of Snowy Plovers and led to the listing of the Pacific Coast Population of Western Snowy Plovers as Threatened on March 5, 1993 (U.S. Fish and Wildlife Service 1993).

We have completed our 21st year of monitoring the distribution, abundance, and productivity of Snowy Plovers along the Oregon coast during the breeding season. In cooperation with federal and state agencies, plover management has focused on habitat restoration and maintenance at breeding sites, predator management through both lethal and non-lethal predator control methods, and management of human related disturbances to nesting plovers. The goal of management is improved annual productivity leading to increases in Oregon's breeding population and eventually sustainable productivity and stable populations at recovery levels. Previous work and results have been summarized in annual reports (Stern *et al.* 1990 and 1991, Craig *et al.* 1992, Casler *et al.* 1993, Hallett *et al.* 1994, 1995, Estelle *et al.* 1997, Castelein *et al.* 1997, 1998, 2000a, 2000b, 2001, and 2002, and Lauten *et al.* 2003, 2005, 2006, 2006b, 2007, 2008, and 2009). Our objectives for the Oregon coastal population in 2010 were to: 1) estimate the size of the adult Snowy Plover population, 2) locate plover nests, 3) continue selective use of mini-exclosures (MEs) to protect nests from predators and evaluate whether exclosure use can be reduced, 4) determine nest success, 5) determine fledging success, 6) monitor brood movements, 7) collect general observational data about predators, and 8) evaluate the effectiveness of predator management. The results of these efforts are presented in this report.

Study Area

We surveyed Snowy Plover breeding habitat along the Oregon coast, including ocean beaches, sandy spits, ocean-overwashed areas within sand dunes dominated by European beachgrass (*Ammophila arenaria*), open estuarine areas with sand flats, a dredge spoil site, and several habitat restoration/management sites. From north to south, we surveyed and monitored plover activity at Sutton Beach, Siltcoos River estuary, the Dunes Overlook, North Tahkenitch Creek, Tenmile Creek, Coos Bay North Spit (CBNS), Bandon Beach, New River (south from Bandon Beach to the south end of the habitat restoration area), and Floras Lake (Figure 1). A description of each site occurs in Appendix A.

Methods

State and federal agency personnel and volunteers conducted pre-breeding surveys at historical nesting sites between Clatsop Spit, Clatsop Co. and Pistol River, Curry Co. in early April 2010. The pre-breeding surveys have been implemented since 2001 to locate any plovers attempting to nest at historic (currently inactive) nesting areas. Agency personnel also assisted surveying plovers during breeding season window surveys in late May. Breeding season window surveys were implemented at both currently active and historic nesting areas. Historic nesting areas surveyed in either early spring or during the breeding window survey include: Clatsop Spit, Necanicum Spit, Nehalem Spit, Bayocean Spit, Netarts Spit, Sand Lake South Spit, Nestucca Spit, Whiskey Run to Coquille River, Sixes River South Spit, Elk River, Euchre Creek, and Pistol River.

Breeding season fieldwork was conducted from 8 April to 27 September 2010. Survey techniques, data collection methodology, and information regarding locating and documenting nests can be found in

Castelein *et al.* 2000a, 2000b, 2001, 2002, and Lauten *et al.* 2003. No modifications to survey techniques were implemented in 2010.

Plover nests were not exclosed during April and into early May until peak raptor migration was believed to have passed (Castelein *et al.* 2001, 2002, Lauten *et al.* 2003). From mid-May to August, we used mini-exclosures (MEs, Lauten *et al.* 2003) to protect plover nests at South Siltcoos, Tenmile, Bandon Beach and New River. Exclosures were not used at Sutton Beach, North Siltcoos, Overlook, North Tahkenitch, or CBNS. There was only one nest at Sutton Beach in late April before exclosure use was implemented. Predation pressure at North Siltcoos, Overlook and North Tahkenitch in 2010 was low and most failures were attributed to non-predator related causes; therefore we did not use exclosures at these sites because there was little evidence that exclosure use would have increased nest success. At CBNS, most nest failures, as in the previous several years (Lauten *et al*. 2008 and 2009), were attributed to rodent depredation and there were no known corvid depredations, therefore exclosures were not used because they would not have prevented these depredations from occurring. At South Siltcoos, Tenmile, Bandon Beach, and New River, predation pressure warranted use of exclosures.

Lethal predator management occurred at all active nesting areas; corvids (*Corvus sp*.) were targeted at all nesting sites and some mammal trapping, specifically targeting red fox (*Vulpes vulpes*), striped skunks (*Mephitis mephitis*), raccoon (*Procyon lotor*), coyote (*Canis latrans*), and deer mice (*Peromyscus maniculatus*) occurred at specific sites. No avian predators other than corvids were targeted or removed in 2010. For information regarding the predator management program, see Burrell (2010).

Male Snowy Plovers typically rear their broods until fledging. In order to track the broods we banded most nesting adult males, sometimes the female, and most hatch-year birds with both a USFWS aluminum band and a combination of colored plastic bands. Trapping techniques are described in Lauten *et al.* 2005 and 2006. We monitored broods and recorded brood activity or adults exhibiting broody behavior at each site. Chicks were considered fledged when they were observed 28 days after hatching.

We estimated the number of Snowy Plovers on the Oregon coast during the breeding season of 2010 by determining the number of uniquely color-banded adult Snowy Plovers observed, and added our estimate of the number of unbanded Snowy Plovers present. We used two techniques to estimate the number of unbanded plovers. We used the 10 day interval method described in Castelein *et al.* 2001 and the daily observation evaluation method described in Castelein *et al.* 2001, 2002 and Lauten *et al.* 2003. We estimated the breeding population by tallying the number of known breeding plovers. Not all plovers recorded during the summer are Oregon breeding plovers; some plovers are recorded early or late in the breeding season indicating that they are either migrant or wintering birds. Plovers that were present throughout or during the breeding season but were not confirmed breeders were considered Oregon resident plovers. We estimated an overall Oregon resident plover population by adding the known breeders with the number of plovers present but not confirmed nesting during the breeding season.

We determined the number of individual banded female and male plovers and the number of individual unbanded female and male plovers that were recorded at each nesting area along the Oregon coast from the beginning until the end of the 2010 breeding season. Data from nesting sites with a north and south component (Siltcoos, Overlook, and Tenmile) were pooled because individual plovers use both sides of these estuaries. Data from CBNS nesting sites were all pooled for the same reason. We also pooled the data from Bandon Beach, New River, and Floras Lake because despite the relatively long distance from the north to the south end (10-12 miles), the plovers that use these nesting sites interchange and move freely between the areas. A tally from each individual site would result in the appearance that more plovers are using the area than actually were present. The total number of individual plovers recorded at each site indicates the overall use of the site, particularly where plovers congregate during

post breeding and wintering. We also determined the number of individual breeding female and male plovers for each site. The number of individual breeding adults indicates the level of nesting activity for each site.

We calculated nest success using apparent nest success and the Mayfield method of nest success (Mayfield 1961, Mayfield 1975). We calculated overall apparent nest success, which is the number of successful nests divided by the total number of nests, for all nests and for each individual site, and overall Mayfield nest success for all nests. We also calculated an adjusted Mayfield nest success for both exclosed and unexclosed nests. The adjusted nest success calculations for exclosed nests eliminated infertile nests because they did not fail due to an extrinsic cause (i.e., depredation or an environmental factor) and adults incubated the eggs longer than the typical incubation period, which would bias the Mayfield calculations. One egg nests, nests found that had already failed or hatched, or nests that were never clearly active were eliminated from unexclosed nest success calculations. For the Mayfield calculations, these failed nests have a survival rate of zero because the nests have no known active dates, and therefore the calculation is divided by zero unexclosed days. Adding nests with no survival rates would bias the calculations to lower estimates of survival. We compared apparent nest success of exclosed and unexclosed nests by Chi-square analysis.

We calculated brood success, the number of broods that successfully fledged at least one chick; fledging success, the number of chicks that fledged divided by the number of eggs that hatched; and fledglings per male for each site.

We continue to review plover productivity prior to lethal predator management activities compared to productivity after implementation of lethal predator management. We specifically continue to evaluate the changes in hatch rate, fledging rate, productivity index, and fledglings per male from prior to lethal predator management compared to years with lethal predator management. The productivity index is a measure of overall effort based on how many fledglings the plovers produced compared to how many eggs they laid. If plovers produced high numbers of fledglings compared to eggs laid, then their productivity was high for the amount of effort (eggs laid) and the productivity index would be high. If plovers produced low numbers of fledglings compared to high numbers of eggs laid, then their productivity was low and the productivity index would be low. In general, a site with productivity index higher than 20% is considered good, while a site with productivity index less than 20% is usually not very productive. We used t-test to compare the mean fledging rate and the mean number of fledglings per male prior to predator management (1992-2001) to post predator management (2004-2010). We did not include the years 2002 and 2003 in the analysis because three sites (CBNS, Bandon Beach, and New River) had predator management in those years but all other sites did not.

Results

Abundance

Pre-breeding April surveys and the late May window survey at sites identified as suitable plover breeding habitat between the Columbia River and Pistol River, Curry Co. did not detect any plovers or plover activity outside of known nesting areas. The annual breeding window survey in late May counted 158 plovers (Table 1), the highest number of plovers ever detected.

During the 2010 breeding season, we observed an estimated 232-236 adult Snowy Plovers at breeding sites along the Oregon coast (Table 1). Of 232-236 plovers, 205 (87-88%) were banded. For unbanded plovers, the 10 day interval method estimated 22 unbanded plovers were present, but using the daily observation evaluation method, an estimate of 27-31 unbanded plovers were present during the

breeding season. For the breeding season, we observed 102 banded females, 103 banded males, 20-23 unbanded females, and 7-8 unbanded males. The totals include one male plover known to have been depredated inside an exclosure at New River, and a second male plover that was found dead along the estuary at North Siltcoos after his nest hatched. Five other resident plovers disappeared during the breeding season, suggesting they may have been depredated or perished.

Of the total estimated population, 175 plovers (74-75%) were known to have nested (Table 1), slightly less than the mean percentage for 1993-2009 (79%). A minimum of 70 banded females and 18 unbanded females nested and 84 banded males and 3 unbanded males nested. An additional 24 banded females and 17 banded males were present during the breeding season but were not confirmed nesting. The estimated Oregon resident plover population was 215.

In 2009 the estimated adult plover population was 199-206, of which 172 were banded. Of these 172 banded adult plovers, 38 (22%) were not recorded in Oregon in 2010, and we received no reports of their being sighted elsewhere in the range. Thus they are presumed not to have survived winter 2009-2010. The estimated overwinter survival rate based on returning banded adult plovers was 78%, above the 1994 – 2009 mean of 63%.

During the 2010 season, we captured and rebanded 33 banded adult plovers - 21 were males and 12 were females; we banded six unbanded adult plovers - five were males and one was a female; and we banded 206 chicks.

2009 Hatch-Year Returns

Due to analysis of hatch year returns, we adjusted the 2009 fledgling total to 107 from 106. Fifty-four of the 107 hatch-year plovers from 2009 returned to Oregon in 2010. The return rate was 50%, slightly higher than the average return rate for 1992-2009 (Table 2, 46%). Of the returning 2009 hatch-year birds, 30 (56%) were females and 24 (44%) were males. Thirty-eight of the hatch year 2009 returning plovers attempted to nest (70%), and they accounted for 26% of the banded adults.

Distribution

Table 3 shows the number of individual banded and unbanded adult plovers and the number of breeding adult plovers recorded at each nesting area along the Oregon coast in 2010. Sutton Beach had three plovers after two years of no plover detections. CBNS and Bandon Beach/New River/Floras Lake had the highest number of plovers. On Forest Service sites, Tenmile and Overlook had the highest use, while Tahknenitch continues to have relatively low plover numbers.

Nest Activity

We located 261 nests during the 2010 nesting season (Table 4), the highest number of nests found since monitoring began in 1990. In addition we recorded two broods from nests that we did not locate prior to hatching.

There was one nest attempt at Sutton Beach (Figure 2), the first nest attempt since 2007.

At North Siltcoos (Figure 3), 17 nests were found and at South Siltcoos 24 nests were found, the highest number of nests recorded for the south side. Forty-one total nests were found, the highest number of nests ever found at Siltcoos (Table 4). Ten nests at North Siltcoos (59%) and 11 nests at South Siltcoos (46%) were found in spread shell hash.

At North Overlook 21 nests were found in 2010, the highest number of nests found at this site (Table 4, Figure 4). Twelve of the nests (57%) were found in spread shell hash. One nest was found in the vicinity of Carter Lake trail access, and a brood from an undiscovered nest was also found in this area and likely originated from somewhere along the foredune between Wax Myrtle trail access and North Overlook. South Overlook had 16 nests, three times as many nests as any previous year. One nest was found along the foredune approximately 50 meters north of the Overlook loop trail, which is south of the habitat restoration area. One brood from an undiscovered nest was also found at South Overlook.

At North Tahkenitch, seven nests were found in 2010 (Figure 5), similar to the previous two years.

At North Tenmile, 13 nests were found in 2010, similar to the previous two years (Table 4, Figure 6). At South Tenmile, 30 nests were found, 11 fewer than 2009, but more than previous years. Forty-three total nests at Tenmile was the second highest total recorded for this site.

At CBNS (Figure 7), 64 nests were found in 2010 (Table 4), one less than in 2009, and the second highest number of nests found at this site. Forty-seven nests were on the nesting area: South Spoil had 14 nests, the 94 Habitat Restoration Area (HRA) had 11 nests, the 95HRA had 13 nests, and the 98EHRA had nine nests. Eight of the 13 nests (62%) on the 95HRA were in spread shell hash. South Beach had 17 nests, the second consecutive year with high nest numbers on the beach. In addition, some nests on South Beach were further north than in previous years, and we documented for the first time a nest north of the FAA towers and outside of the motor vehicle closure area.

At Bandon Beach (Figure 8), 26 nests were found in 2010 (Table 4). Five nests were found in the China Creek area, including three on the south side below the parking lot and two north of China Creek. Three of these nests hatched, including the two on the north side. Fourteen nests were found on the HRA, including two along the foredune south of the maintained area of the HRA and just north of the mouth of New River. The remaining nests were in China Creek overwash and south along the foredune to the HRA. Including 12 nests found on state land on the south side of the mouth of New River, a total of 38 nests were found within Bandon State Natural Area.

At New River (Figure 8 and 9), 42 nests were found in 2010, two more than in 2009 and the highest number of nests ever found at New River (Table 4). Twenty-three of the 42 nests were found on the BLM HRA and four other nests were on BLM land just north of the HRA. Nests on the HRA were found from the north end to along the beach between New Lake breach south to Hammond breach. For the third year in a row, two nests were found on Clay Island breach south of the maintained HRA. Two nests were found on Michael Keiser's property, and one nest was along the foredune further south on private land. Twelve nests were found on state land from Lower Fourmile access north.

There were no plover nests found at Floras Lake in 2010, and only one plover was recorded on one date at this location.

The first nests were initiated about 13 April (Figure 10). Nest initiation increased into early May, and declined slightly in mid-May before increasing throughout June. The maximum number of active nests (n = 80) during 10-day intervals occurred during 20 - 29 June, a week later than average. The last nest initiation occurred on 25 July.

Nest Success and Exclosures

The overall Mayfield nest success in 2010 was 25%, the second consecutive year with low overall nest success (Table 5). The low overall Mayfield success rate was due to high numbers of abandoned nests, one egg nests, and nests that were never clearly active that add failures to the calculation without adding any exposure days, thus biasing the calculation low. Adjusted Mayfield nest success for all exclosed nests in 2010 was 67%, equal to the mean. For the fourth consecutive year, the number of days nests were unexclosed was higher than the number of days nests were exclosed (2286 unexclosed days, 1205 exclosed days, Figure 11), but the number of exclosed days increased by over double from 2009 and was the highest since 2006. The adjusted Mayfield nest success rate for unexclosed nests in 2010 was 30%, above the overall mean for unexclosed nests.

In 2010, the overall annual apparent nest success rate was 35% (Table 6), similar to the previous two years (2008 =34% and 2009 = 33%) and below the 21-year mean of 48% (Table 7). The number of exclosed nests in 2010 (n = 67, 26%) was higher than in the previous two years (2009, n = 34, 14% and 2008, n = 51, 26%). Apparent nest success for exclosed nests in 2010 was 72%, similar to 2009 (76%), and nearly the average for all years (x = 70%, Table 7). The number of unexclosed nests in 2010 (n = 194, 74%) was lower than in 2009 (n = 202, 86%) but higher than previous years (2008, n = 140, 71%; 2007, n = 164, 81%; and 2006, n = 79, 54%). Apparent nest success for unexclosed nests in 2010 was 23%, similar to 2009 (25%), and higher than the overall mean for unexclosed nests (x = 17%, Table 7). Nest success of unexclosed nests in 2010 was significantly lower than nest success of exclosed nests (χ^2 = 47.7765, df = 1, $P < 0.01$).

There was only one nest at Sutton Beach in 2010. The nest was found on 24 April with one egg, and was determined to be abandoned within several days. Further inspection revealed that a second egg had already been buried by wind blown sand prior to finding the nest on 24 April. This nest was never exclosed because it was prior to 15 May.

Exclosures were not used at North Siltcoos in 2010 (Table 6). Seven of 17 nests hatched (41%), above average for this site (Figure 12). Of the 10 that failed, five were either abandoned or one egg nests, and two others were weather related (Table 8). Exclosure use would not have prevented these seven nests from failing. Removing these nests from the total, seven of 10 (70%) hatched. Nests hatched from mid-May to mid-July, and the last three nests to fail at North Siltcoos were abandoned or one egg nests. Nest data and observational information about predators did not support exclosure use at this site.

At South Siltcoos, six of 24 nests hatched (19%), below the average for this site (Figure 12). Of 24 nests at South Siltcoos, 18 were unexclosed (75%, Table 6). All of the 18 unexclosed nests failed (Table 8). Seven of the 18 (39%) failed unexclosed nests were not caused by depredations (Table 8), therefore exclosures would not have prevented their failure. There were five known depredations (28%) and rodents were responsible for two of the depredations. Exclosures would not have prevented these rodent depredations from occurring. Six nests failed to unknown causes (33%), three of which occurred prior to 15 May when exclosures were not used. Of 18 failed unexclosed nests, 12 failed nests (67%) were either prior to 15 May or exclosure use not would not have prevented the failure. Due to at least one corvid depredation and observed corvid activity, six nests were exclosed (25%) at South Siltcoos and all six exclosed nests hatched. Overall at Siltcoos, 32% of the nests were successful (Table 6), near the average for these two sites (Figure 12).

Exclosures were not used at Overlook in 2010 (Table 6). There were 21 nests at North Overlook, and 13 hatched (62%), well above the average for this site (Figure 12). Of the eight that failed, none were documented depredations, and five (63%) were either abandoned or one egg nests. At South Overlook

there were 16 nests, and only three hatched (19%), much below the average for this site (Figure 12). However, of the 13 that failed, eight (62%) were abandoned or one egg nests, one was overwashed, and one failed to weather related factors (Table 8). Of the remaining three failed nests, only one was a documented depredation and that occurred on 24 April, prior to exclosure use. The other two failed nests were due to unknown causes, however neither nest was depredated as evidence at both nests indicated that weather likely played a role in the nests failing. Therefore three of four nests that were not abandoned or impacted by weather related factors hatched. The lack of depredated nests and observational information about predators determined that exclosure use was unwarranted at Overlook. Overall for Overlook, nests success was 43% (Table 6), above the averages for these two sites (Figure 12).

Exclosures were not used at Tahkenitch in 2010 (Table 6). Three of seven nests hatched (43%), average for this site (Figure 12). Of the four nests that failed, three were one egg nests and one was infertile. Observational information noted that corvid activity was minimal, and therefore exclosures were not used at Tahkenitch.

Overall at Tenmile, 18 of 43 nests were successful (42%, Table 6), average for these two sites (Figure 12). Only one unexclosed nest of 21 hatched (5%). At North Tenmile, all eight unexclosed nests failed, and four of the five exclosed nests hatched (80%). Of the eight unexclosed nests that failed, four (50%) were due to depredations. Overall at North Tenmile, 31% of the nests hatched (Table 6), below average (Figure 12). At South Tenmile, one of 14 unexclosed nests hatched (7%), and 13 of 16 exclosed nests hatched (81%). Ten nests failed to depredations, although it was unclear whether corvids or mammals were responsible for the majority of failures (Table 8). Overall predators were responsible for 14 of 24 failures at Tenmile (58%). Eight of these depredations (57%) occurred before 15 May. Due to the predator pressure at this site, we exclosed at total of 21 nests (49%) and 17 (81%) hatched.

No exclosures were used at CBNS for the fourth consecutive year (Table 6). Overall at CBNS, 16 of 64 nests hatched (25%). Two of 14 nests hatched on South Spoil (14%) and five of 33 nests hatched on the HRAs (15%), well below the averages for these sites (Figure 12). As in 2009, after repeated failures on the nesting areas, plovers moved to South Beach. Nine of 17 nests on South Beach were successful (53%), much higher than the nesting areas and slightly below the average (Figure 12). The majority of failed nests were caused by depredations (81%, Table 8). Rodents were responsible for 46% of the depredations and 54% of the depredations were classified as unknown. There were no corvid depredations, and observation information indicated a lack of corvids or other large mammalian predators other than occasional coyotes. Based on evidence at the depredated nests (i.e., lack of mammalian or avian tracks) and other evidence of predators on site, most of the unknown depredations were likely due to rodents. Exclosures do not prevent rodent depredations, therefore exclosures were not used at CBNS.

At Bandon Beach, 11 of 26 nests hatched (42%, Table 6), above the average for this site (Figure 12). Thirteen nests were unexclosed and all failed. Thirteen other nests were exclosed and 11 hatched (85%). Six nests failed to depredations (40%) and eight nests failed to unknown causes (53%, Table 8). Of the depredated nests, two failed to corvids, one to rodents, and three to unknown predators. Of the eight nests that failed to unknown causes, many of these nests failed quickly and during periods of inclement weather, so it was not clear if these nests failed to predator related causes or weather related causes. Based on depredated nests and observational information about predators, exclosure use was warranted at this site. Eleven hatched nests at Bandon in 2010 was higher than the combined total of hatched nests for the past two years (n = 8, Lauten *et al*. 2008 and 2009).

At New River, 15 of 42 nests hatched (36%, Table 6), below average for this site (Figure 12). Two of 15 unexclosed nests hatched (36%), one just north of the HRA and one on state land. Thirteen of 27 exclosed nests hatched (48%), including nine of 18 nests on the HRA (50%) and four of nine on state

and private lands (44%). Seventeen of 25 failed nests (68%) were caused by a variety of predators (Table 8). Two exclosed nests failed due to skunks entering the exclosure, one exclosed nest failed to rodents, and one exclosed nest failed after the adult male was found depredated inside the exclosure. Corvids were responsible for only one known depredation. Based on nest failures and observational information about predators, exclosure use was warranted at this site.

Nest Failure

Exclosed nests in 2010 had an overall failure rate of 27% (18 of 67, Table 9), higher than in 2009 (18%), but similar to previous years (49% in 2008, 29% in 2007, 34% in 2006, and 27% in 2005). Fourteen failed exclosed nests (78%) were caused by non-predator related factors (Table 9). Five exclosed nests failed to predators (28%), including skunks that entered two exclosures. One adult was found depredated inside an exclosure by an unknown predator. The number of unexclosed nests that failed in 2010 (n = 149) was nearly the same as 2009 (n = 148), and higher than the previous two years (2008, n = 102 and 2007, n = 104). The failure rate of unexclosed in 2010 (77%) was higher than the previous four years (73% in 2009, 73% in 2008, 66% in 2007 and 68% in 2006). In 2010, the main causes of nest failure for unexclosed nests were unknown depredations (n = 39, 26%), unknown cause (n = 26, 17%), one egg nests (17%), and rodent depredation (n = 22, 15%, Table 9). Overall nest failures were attributed to unknown depredation (24%), unknown cause (17%), one-egg nests (15%), rodent depredation (14%), abandonment (12%), wind/weather (5%), corvid depredation (5%), mammalian depredation (4%), wave overwash (2%), infertility (2%), and adult depredation (1%, Table 8).

As the number of nests found increases, the number of one-egg nests (n = 25 for 2010, n = 19 for 2009, n = 22 in 2008, and n = 23 for 2007) and abandoned nests (n = 20 for 2010, n = 11 for 2009, n = 19 in 2008, n = 18 in 2007) continues to be high. Of 157 abandoned and one egg nests in the past 4 years, 19 were exclosed (11%).

Fledging Success and Productivity

We monitored 94 broods in 2010 including two broods from undiscovered nests, six more broods than in 2009 (Lauten *et al*. 2009). A minimum of 80 fledglings was confirmed (Table 10). Overall fledging success was 33%, the lowest since 2002 and the first time below the average since implementation of predator management (Table 11). The overall number of fledglings per male was 0.90 (80/89, Table 12). Using the productivity data from Siltcoos to New River only (Tables 14 - 20), the mean fledglings per male was 0.875, the lowest since 2002 (Table 13).

The overall brood success rate was 55% (Table 12), lower than the average (67% +/- 11) and the lowest since 2002. Siltcoos had 13 broods, one more than 2009, and 54% of the broods were successful (n = 7/13). Overlook had 18 broods, 13 more than 2009, and 11 were successful (61%). Tahkenitch had three broods, two that were successful. Tenmile had 18 broods, three more than 2009, and overall brood success was 50% (n = 9/18). CBNS had ten fewer broods compared to 2009, and overall brood success rate was 75% (n = 12/16). Bandon Beach had twice the number of broods in 2010 compared to 2009, but the same number of broods was successful (n = 4/11). At New River, none of the broods on state or private land were successful. Seven of 10 broods on the HRA were successful, and overall brood success at New River was 47% (n = 7/15).

Overall fledging success at Siltcoos was 27% (Table 14), with 24% success on the north spit and 31% success on the south spit (Table 12). Overlook had an overall fledging success rate of 38% (Table 15), with 29% success on the north side and 75% success on the south side (Table 12). Tahkenitch had a 29% fledging success rate, but only produced two chicks (Table 12 and 16). Overall fledging success at

Tenmile was 29% (Table 17), with 30% success on the north spit and 29% success on the south spit (Table 12). CBNS had an overall fledging success rate of 48% (Table 18). South Spoil fledged only two chicks and had a fledging success rate of 40%, the HRAs had a 31% fledging success rate and South Beach had a 59% fledging success rate (Table 12). Bandon Beach had the lowest fledging success rate at 19% (Table 12 and 19). Overall fledging success at New River was 33% (Table 20). The HRA had a fledging success rate of 50% (Table 12). No broods were successful on state or private land.

Productivity was down in 2010 (Tables 14 - 20). At Siltcoos in 2010 (Table 14), hatch rates decreased by 20 percentage points compared to 2009, and the number of fledglings, the fledging success rate, and the number of fledgling per male all decreased by nearly half. The number of eggs laid was twice the number laid in 2009, the highest number ever, indicating high effort by the plovers. However, the productivity index decreased by over 20 percentage points due to the small numbers of fledglings produced for the amount of effort. Overall productivity indices were below the post predator management averages and goals at Siltcoos.

Productivity at Overlook was some of the highest on the coast in 2010 (Table 15). The hatch rate was similar to 2009, but the fledging success rate and number of fledglings per male declined substantially and were below post predator management averages for this site. The number of eggs laid was nearly three times higher than in 2009, and the number of fledglings produced was six more than 2009. Due to the high number of eggs laid (i.e., effort), the productivity index was fairly low indicating few fledglings for the amount of effort. However, Overlook did reach recovery goals and produced more fledglings in 2010 than in any other year for this site.

Tahkenitch had improved productivity for the second consecutive year, however sample sizes remained relatively small and therefore subject to much variance (Table 16). The hatch rate increased slightly in 2010 and was above post predator management average. Fledging success and the number of fledglings per male improved, but still remain lower than recovery goals.

At Tenmile (Table 17), the hatch rate improved from the previous two years and was near average for post predator management years. However, the fledging success rate and the number of fledglings per male declined by half and were below post predator management averages. The number of eggs laid was similar to 2009 as was the number of fledglings produced. The productivity index remained poor, indicating much effort for the number of fledglings produced. This was the first year since predator management was implemented that Tenmile did not produce 1.00 fledglings per male.

Overall productivity at CBNS declined for the second consecutive year (Table 18) but remained above recovery goals. The hatch rate declined to its lowest level ever and well below the post predator management average. The fledging success rate was the same as 2009, but below the post predator management average. The number of fledglings per male declined, was the lowest since 1997 and below the post predator management average. The number of eggs laid was similar to 2009, but there were nine fewer fledglings resulting in a poor productivity index. The number of fledglings produced was the lowest since 2002. CBNS still remains the only site that has reached recovery goals every year.

While Bandon Beach had a much improved hatch rate in 2010 compared to the previous two years, productivity continued to be poor for the amount of effort (Table 19). The fledging success rate declined because more eggs hatched but the same number of fledglings was produced compared to 2009. The number of fledglings per male remained the same compared to 2009 and below recovery goals.

Overall productivity at New River also declined in 2010 (Table 20). About the same number of eggs was laid in 2010 compared to 2009, but the hatch rate declined and was below post predator

management average. There were also fewer fledglings produced, therefore the fledging success rate declined and was below post predator management average. The number of fledglings per male declined and was below recovery goals. The high number of eggs laid and the relatively few fledglings produced indicated much effort but poor productivity for the effort, and therefore the productivity index declined.

The overall mean post predator management fledging success rate (0.47, Figure 13) was higher than the mean pre predator management fledging success rate (0.39), but was not significant ($t = 1.67$, $df = 15$, $P = 0.11$). The overall mean number of fledglings per male prior to predator management (Table 13, 1992-2001; $x = 1.056$) was significantly lower than the mean number of fledglings per male post predator management (2004-2010; $x = 1.31$, $t = 2.079$, $df = 15$, $P = 0.05$, Figure 14). Productivity as measured by the average fledging success rate and the average number of fledglings per male has improved at Siltcoos, Overlook, CBNS, Bandon, and New River, since implementation of predator management (Tables 14, 15, 18, 19, and 20). At Tahkenitch and Tenmile (Tables 16 and 17) productivity has remained relatively stable.

Brood Movements

Broods at North Siltcoos used the HRA and spit, and no broods were known to have moved north. Two of seven broods crossed the river to the south spit. One of these broods was seen crossing the river to the south side, and was later confirmed fledged on the north side, however it was unclear whether the brood fledged on the south or north side. Another brood crossed the river and continued south to the Carter Lake trailhead area, where it fledged. Of the four broods on the south side, three moved south to the Carter Lake trailhead area. In addition, there were two broods from the vicinity of Carter Lake trailhead.

At North Overlook, two broods moved north along the foredune to the Carter Lake trailhead area and fledged chicks. Two other broods moved south to the south side and one continued further south along the foredune towards North Tahkenitch. One brood from South Overlook moved south along the foredune to North Tahkenitch within a week of hatching and fledged chicks at North Tahkenitch. Another nest hatched along the foredune south of South Overlook near the Overlook Loop trail, and stayed near that area until it fledged. As in previous years, plovers continue to use the foredune and beach between South Siltcoos and North Overlook, and are now using the beach from South Overlook to North Tahkenitch. These sections of beach are not currently roped or signed.

There were three broods at North Tahkenitch and all remained on the nesting area and beach. Of interest, a first year male was found buried up to his neck at one of the hatched unexclosed nests, barely alive. Apparently one egg had hatched, and the female brooded the chick and moved away. The male continued to incubate the other two eggs. The weather at the time was very windy, and when the nest was checked on the next visit the male was found with his head protruding from the sand. He was quickly unburied, and it was discovered that his legs were fully extended, but the two eggs remained under him. It is not clear why this male continued to incubate eggs as the sand accumulated around him, but apparently he got stuck at some point. The monitoring crew revived the shocked plover by rehydrating him as well as providing an opportunity to warm himself and regain his strength. After about an hour, the plover was resuscitated, and independently moved away. He was seen broody several days later, but his brood eventually failed. He survived through the end of the season. We have recorded two previous adult female plovers being buried under sand (unpubl. data and Lauten *et al*. 2007). In both cases, the nest was under a log, and wind blown sand accumulated around the log until it collapsed on the incubating female. Both females perished. In this case, there were no logs or other beach debris around the nest bowl to trap blown sand. We have never recorded nor heard of any incident like this in the past.

At least one brood at North Tenmile used the foredune north of the nesting area, but did not move further north than several hundred meters from the nesting area. Broods at South Tenmile stayed mostly within the vicinity of the HRA, but were often noted using the beach and the spit. There was some brood use at South Tenmile along the foredune to north of the boundary of the closed area.

There were seven broods from the nesting area at CBNS, and as we have documented in the past, the broods tended to move west, using the 95HRA and South Beach for the majority of the brood period. South Beach, from the north jetty to north of the Olson shipwreck, and the adjacent 95HRA, remain the most used areas for brood rearing. The sloped foredune and areas of scattered vegetation permit broods to move freely and easily about the nesting areas and from the nesting areas to the beach. Gaps in the berms along the foredune permit plover broods to move westward toward the beach where food resources are highest. Broods from South Beach continue to use the north jetty area despite the often heavy vehicle traffic on beach and along the access area. We found two nearly fledged broods running around the parking area overlooking the beach at the north jetty, and one nearly fledged chick was found along the foredune road half way to the bay beach. At the north end of the beach, the brood that hatched north of the FAA towers was found in tire ruts west of the carsonite signs erected to protect the nest. This brood was later found near the Olson shipwreck, well inside the closed area, and it later fledged. No broods from South Beach moved north of the closed area.

At Bandon Beach, of the five nests near China Creek, including two north of China Creek, three hatched. All three of these broods, including the two from north of the creek, moved south within several days of hatching. The majority of brood use from broods near China Creek or along the foredune was from about half the distance to the HRA to the north end of the HRA. Broods from the HRA moved north or south along the foredune as well as stayed on the HRA. The southern half of the beach, which is the least disturbed by human activity, had the highest levels of brood use.

Broods from state and private land at New River stayed in the vicinity of their nests, but no broods survived this year and therefore there were no major brood movements. One brood from just north of the HRA moved as far south as between Croft and New Lake breach. Broods from the north end of the HRA tended to stay north of Croft Lake breach, while broods from the Croft Lake breach to New Lake breach area tended to stay along the foredunes north and south of the these areas. One successful brood from Clay Island breach moved north along the foredune to the south end of the HRA south of New Lake breach.

Activity Patterns on HRAs

In past years we have shown activity patterns of plovers on four habitat restoration areas: Overlook, CBNS, Bandon Beach, and New River (Lauten *et al*. 2003, 2004, 2005, 2006, 2007, 2008, and 2009). All nesting areas have received a variety of habitat treatment, and therefore clarifying what HRAs are has become more complicated. HRAs are very important aspects to plover management, and plovers continue to use these areas for roosting, nesting, brooding, and feeding activities. The improvement of these areas through mechanical treatment and shell hash spreading is evident in the use of these areas by plovers for all aspects of their ecology. All nesting areas with any type of treatment were used in 2010 for all plover activities.

Sightings of Snowy Plovers Banded Elsewhere

Nineteen adult plovers banded in California or Washington were observed in Oregon in 2010. Twelve were females and seven were males. Ten of the 19 plovers were known to have nested in Oregon in 2010 including five females and five males. Seven females and four males originally hatched in

Oregon and were subsequently rebanded at coastal nest sites in California. Three of these Oregon originated males nested in Oregon in 2010, and the fourth was present only in the beginning of the season and was not seen after 12 April. This latter male had nested at Tenmile the previous year, so it is possibly that he was depredated. Of the seven Oregon originated females, three nested in Oregon in 2010. One other female was seen at Tenmile through 11 May, and had been a resident at this site in 2009. She may have been depredated. The other three females included a bird that has wintered in past years at Bandon Beach and was first recorded at Bandon Beach in mid-July and remained through the end of the season; a female recorded at Siltcoos in August only; and a female recorded from the end of July through August at South Beach, CBNS.

One of the female plovers was a HY07 bird from Washington. She was present at Overlook in April where she has been known to winter. She was present during the summer of 2009, but did not nest. It is unclear if she left the area or was depredated.

The seven other plovers, four females and three males, were originally banded in California. Two females were banded as chicks in Humboldt Co. One female was a HY07 plover rebanded in 2008; she nested at New River HRA in 2008, 2009, and 2010. The second female still retains her HY band combo, so we are uncertain what year she originally hatched. She nested at New River in 2008 and 2009, but we did not confirm a nest in 2010, however she was present all summer. The other two females were a HY06 from Salinas NWR, and a HY08 from Oceano Dunes, San Luis Obispo Co. The HY06 female was recorded throughout June, but was not known to have nested. The HY08 female was associated with a nest at CBNS. One male was a HY04 from Salinas NWR, and has nested at New River since 2006. The second male was banded at Salinas NWR in June of 2009, and arrived at Bandon Beach in early August for the second consecutive year and was present for the remainder of the season. The third male was a Humboldt Co. HY09 bird that arrived at CBNS in early June and successfully nested on South Beach.

Discussion

All indices of Snowy Plovers numbers on the Oregon coast in 2010 were the highest totals tallied since monitoring began in 1990 (Table 1). The window survey count increased by about 12 – 15 plovers, the number of breeding plovers increased by about 25, and the overall number of plovers increased by 30 – 35 birds, the largest increase in five years. The number of breeding plovers continues to become more difficult to accurately assess due to several factors. Adults from nests that fail quickly are difficult to determine. As nest densities increase, ability to identify associated adults has become more difficult. On larger nesting areas with high nest densities like CBNS and Tenmile, it can be very difficult to associate adults with a particular nest. Adults do not typically stay on the nest while monitors are close by. For this reason, we limit our time at nesting areas to minimize disturbance to adults and nests. In addition, because we have been using fewer exclosures, we approach unexclosed nests less often to minimize human activity around unprotected nests. The result has been fewer opportunities to identify adult plovers moving away from nests in response to approaching monitors. The window survey is subject to both survey conditions and plover detectability, and thus continues to be some factor below the true population. The number most likely to represent the nesting population of Oregon is the number of resident plovers. The number of resident plovers in 2010 was 23 – 30 plovers higher than in 2009 (n = 184 – 185). The Oregon coastal plover population continues to move closer to recovery goals (U.S. Fish and Wildlife Service 2007).

The increase in the plover population is mostly a result of previous years' productivity in combination with overwinter survival rates and to a lesser extent immigration into the population from outside Oregon. In 2009, Oregon plovers produced 107 fledglings (Table 2), and the estimated overwinter survival based on hatch year returns was 48%. Adult overwinter survival was estimated to be

approximately 78%, the highest rate we have ever recorded. The combination of very good overwinter survival rates of both adult and hatch year plovers, and the fact that the number of fledglings in the previous year was high, resulted in higher plover numbers. Only 18 adult plovers banded outside of Oregon were detected in 2010, the same number as 2009 (Lauten *et al*. 2009), and only five were new immigrants, three of which nested. The number of unbanded adult plovers has remained relatively stable for the past three years (27 – 31 in 2010, 28 - 35 in 2009, and 27 - 39 in 2008), as has the number of newly captured unbanded plovers (n = 6 in 2010, n = 10 in both 2008 and 2009). In past years, the number of hatch year returns did not replace the number of adults that did not return (Lauten *et al*. 2008 and 2009). In 2010, 53 returning HY09 plovers was higher than the 38 adult plovers that did not return, again indicating that overwinter survival was important to increasing the plover population. In previous years (Lauten *et al*. 2007, 2008, and 2009), the Oregon population was partially maintained by immigration into the population. For 2010, immigration had a lesser role in the increase in plover numbers. Colwell et al. (2008, 2009, and 2010) has noted that Humboldt Co. populations are maintained by immigration, and Washington populations are also maintained by immigration into that population (S. Pearson, pers. comm.). Immigration continues to be an important aspect of plover biology in Oregon, however Oregon's increasing population is also helping to maintain neighboring plover populations in northern California and Washington.

Nearly all sites along the Oregon coast had a positive change in plover numbers in 2010 (Table 3). Sutton Beach had no plover use in 2009 and only three birds were recorded there in 2010, but there was at least one nest attempt. The overall number of plovers at Siltcoos increased from about 40 individuals in 2009 to 48 in 2010, but the number of breeding individuals remained stable (23 in 2010 compared to 24 in 2009). Overlook had the largest increase in plover numbers on the coast. The number of plovers using the area doubled from 25 – 26 in 2009 to 58 – 59 in 2010, and the number of breeding individuals increased from eight in 2009 to 28 in 2010. The substantial increase in the number of nests at Overlook reflects the higher plover numbers (Table 4). Tahkenitch had a slight increase in plover numbers compared to 2009 (n = 11/4). At Tenmile overall numbers increased from 57 in 2009 to 67 – 69 in 2010, and while there was an increase of 10 nesting plovers, this may be due to better identification of nesting adults more than a real increase in nesting plovers.

Tenmile continues to have high numbers of plovers with nearly 30% of the total number of plovers on the Oregon coast using this site at some point during the year. While the number of nesting plovers increased, the number of nests declined because more nests were successful in 2010 (n = 18) compared to 2009 (n = 12), and therefore there were fewer failures and thus fewer nest attempts. Tenmile has been one of the most productive sites on the Oregon coast (Table 16), however in the past three years the number of fledglings produced compared to the effort (i.e., eggs laid) has been poor. Improvements to habitat and predator management at this site are recommended due to the importance of this site to the Oregon plover population. North Tenmile has some of the best potential for expansion of nesting habitat. At CBNS plover numbers were about 15 higher than in 2009 (n = 57), but the number of breeding plovers was about the same as 2009 (n = 45). CBNS continues to be the most productive site on the Oregon coast (Table 17). High nest numbers at CBNS in 2010 and 2009 (Table 4) were caused by repeated nest failures mainly from rodent depredations, and thus many renest attempts. The total number of plovers using Bandon Beach/New River/Floras Lake declined slightly from 2009 (n = 80 – 82), but the number of nesting adults remained relatively the same (Table 3, n = 49 for 2009). The number of nests also remained essentially the same compared to the last several years (Table 4).

For the second consecutive year, the 2010 breeding season had the highest number of nests since monitoring began in 1990 (Table 4). The increasing plover population contributes to the high number of nests, however, as was the case in 2009, repeated nest failures resulted in many renesting attempts, which resulted in high nest numbers. We continue to document high numbers of one egg and abandoned nests

(Lauten *et al*. 2007, 2008, and 2009). The reasons for the high number of one egg and abandoned nests continue to be difficult to assess. Recreational activity is not a likely cause of these abandonments, as most sites have fairly low direct impact from recreational activity. Exclosure use is also not likely a cause of these failures as only 11% of the nests over the past four years (n = 19/157) have been exclosed. Permitted activity by monitors and Wildlife Services does cause disturbance on the nesting areas, but the level of disturbance at any time is also fairly low, so we do not believe that our activities are the main reason for all these failed nests. We suspect that many of these abandonments are natural and likely not preventable.

In 2009, rodent and unknown depredations accounted for 50% of all nest failures (Lauten *et al*. 2009). In 2010, rodent and unknown depredations accounted for 38% of all nest failures (Table 8). The majority of rodent depredations occurred at CBNS (78%), for the fourth consecutive year (Lauten *et al*. 2007, 2008, and 2009). Cameras were not used in 2010, but evidence at the nest sites was identical to the previous several years: missing eggs, crushed eggs shells in very tiny fragments, spilled egg content, no sign of medium to large predator foot tracks or nest disturbance by any sizable predator, depredations inside exclosed nests, and rodent tracks near nests (Lauten *et al*. 2009). Of the 40 failures attributed to unknown depredations in 2010, 20 (50%) were from CBNS. Observational information on predators at CBNS indicates that corvids were rarely present on the nesting area, and based on the evidence at the depredated nests, corvids were not the cause of these failures. Beginning in June, Wildlife Services set traps to capture deer mice at CBNS (Burrell 2010), and captured 33 individuals, a relatively small number of rodents based on the number of traps and size of the area. It was difficult to determine if the trapping effort had any impact on nest survival partially due to low plover nest density at that time because many plovers were moving to South Beach after repeated failures on the nesting area. The continuing problem of rodent depredations at CBNS is a concern as it has negatively impacted hatch rates and productivity at this site, which has been the most productive site on the coast (Table 18). The predator subcommittee of the Snowy Plover Working Team continues to discuss the matter and attempt to address the problem. We continue to explore the use of cameras to further document the details of what is occurring at these depredated nests, but we caution that camera use is very time consuming (Mark Colwell, pers. comm.). While we continue to better document the problem, solutions to the problems remain difficult to address. For 2011, we plan on earlier use of traps at CBNS to try to reduce the rodent population. Rodent depredations also were documented at Siltcoos, Tenmile, Bandon Beach, and New River, but in much lower numbers than at CBNS (Table 8).

Corvid depredations were documented at Siltcoos, Overlook, Tenmile, Bandon Beach, and New River (Table 8). Corvids were responsible for 21% (n = 8/39) of known depredations. As we have noted in the past, corvids were likely responsible for some of the unknown depredations (Lauten et al. 2006, 2007, and 2008), although rodents were also likely responsible for many unknown depredations. We believe that predator management continues to have a positive effect on reducing corvid numbers and therefore corvid depredations. Controlling corvids continues to be a difficult and time consuming task. Despite apparent reductions in corvid numbers, they continue to be consistently present particularly at Siltcoos, Tenmile, Bandon Beach and New River. Due to the amount of area that needs to be covered and the distance between nesting sites, we continue to recommend that Wildlife Services be funded for three personnel. This was the second season that Wildlife Services employed three agents, permitting more focused attention by staff at Siltcoos to Tahkenitch, Tenmile and CBNS, and the Bandon Beach - New River areas.

Nest success of exclosed nests continues to be much higher than unexclosed nests (Table 5, 6, and 7). However, where predation pressure is low, unexclosed nests can have good success rates. No exclosures were used at North Siltcoos, Overlook, Tahkenitch, and South Beach, and all had nest success rates between 41 – 53% (Table 6), well within published ranges (Colwell et al. 2005, 41 – 51%, Page et

al. 1983, 47%, Powell et al. 2002, 50-58%) and acceptable for ground nesting birds. Exclosures are effective at preventing corvid and large mammal nest depredations, however there are some limitations including an inability to prevent rodent depredations and exposing adults to depredation (Murphy et al. 2003, Neuman et al. 2004, Lauten et al. 2004, 2005, and 2006). In 2010, one adult plover was found depredated inside an exclosure. This is the 41st adult plover since 1995 depredated in or around an exclosure in Oregon in 20 years of monitoring exclosure use (Lauten, unpulbl. data). Adult survival has been shown to be extremely important to population dynamics (Sandercock 2003, USFWS 2007). In Humboldt Co., California, exclosure use was discontinued in 2006 when adults were found depredated in exclosures (Colwell *et al*. 2010). It is important to limit exclosure use to reduce adult depredations, especially when it is determined that exclosures are not necessary to obtain reasonable nest success rates. In 2010, we used exclosures when there were consistent nest depredations that were known or thought to be caused by corvids, or when ORBIC and Wildlife Services staff observed corvids consistently using an area. South Siltcoos, Tenmile, Bandon Beach, and New River all had some level of corvid nest depredations or other observational information that warranted exclosure use. North Siltcoos, Overlook, Tahkenitch, and CBNS all had low corvid activity, and little observational information indicating high corvid or medium and large mammal activity, so therefore exclosure use was not warranted.

When nest success is within expected ranges, additional exclosure use does not translate into improved plover productivity. Exclosure use only has potential impacts on nest and hatch success. Since plover chicks do not stay within exclosures or at the nest bowl, the exclosures have no direct impact on fledgling productivity. At Siltcoos (Table 14), the hatch rate did not change appreciably between pre and post predator management years, but the fledging success rate increased by 30 percentage points, the number of fledglings per male increased by 1.00, and there were 54 more fledglings produced in 4 fewer years. At Bandon Beach (Table 19), the hatch rate stayed nearly the same between pre and post predator management years, but the fledging success rate increased by 20 percentage points, the number of fledglings per male increased by nearly 0.50, and there were 51 more fledglings produced in one less year. Hatch rates were basically the same pre and post predator management, but fledging rates, the number of fledglings per male, and the total number of fledglings all changed substantially at both these sites. Exclosure use had no impact on fledgling production because exclosure use was relatively the same in both time periods, and hatch rates did not change. Further illustrating how exclosure use has a limited effect on plover productivity, at Overlook (Table 15), the hatch rate has declined by almost 14 percentage points between pre and post predator management years, but the fledging success rate increased by 10 percentage points, the number of fledglings per male increased by 0.50, and 43 more chicks fledged in two more years. At Tenmile (Table 17), the hatch rate decreased 17 percentage points, yet in this case fledging success and the number of fledglings per male were nearly the same pre and post predator management. There were an additional 38 fledglings produced in five fewer years. At CBNS (Table 18), the hatch rate decreased by 14 percentage points between pre and post predator management years, and in this case fledging success and the number of fledglings per male both increased, but not dramatically. However, 67 additional fledglings were produced in one less year. In these three cases, the hatch rate declined by more than 10 percentage points, yet fledging success either stayed the same or increased. In all cases the number of actual fledglings produced was much higher post predator management, and in fewer to nearly equal years. In all cases, the chicks fledged per male was above 1.00 post predator management. Exclosures were used periodically at all three of these sites. Since lethal predator management began, fewer exclosures have been used than in previous years, which may have contributed to lower hatch rates. Nevertheless, the productivity of all these sites post predator management is greater than during pre predator management years despite using fewer exclosures. The data do not support that relatively minor changes in the hatch rate, with or without exclosure use, will have much impact on plover fledging productivity.

When nest success is low, exclosure use will lead to improved nest success and thus potentially affect plover productivity by increasing the number of hatched chicks available to fledge. However, when nest success is within expected ranges, nest exclosure use, even if it results in increased nest success, will not necessarily result in more chicks and potential fledglings because the number of fledglings produced in a given year is a function of the number of males in the population. The number of nest attempts is a function of the number of available males and the number of failed nests. Higher rates of nest failure result in more nest attempts, but not necessarily more broods. Conversely, increased nest success may lead to fewer nest attempts because males will be occupied with broods. The actual number of potential broods does not change in a given year regardless of the number of nest attempts because it is related to the number of males in the population. The number of nests an individual male attempts in a given year is determined by his success or failure. To summarize, if nest success is very poor, there will be few chicks to fledge but there will be many nests, however, if nest success is average, increasing the nest success will not necessarily lead to more chicks and fledglings, it will lead to fewer nest attempts.

Exclosures continue to be an important management tool, especially where nest success is low and predation from corvids in particular is high. We continue to recommend that exclosure use be minimized to help prevent adult depredations and that they only be erected when there is evidence of persistent corvid or large mammal activity that threatens plover nesting success. The relationship between nest success, exclosure use, predator control, and fledging success is being analyzed further.

This was the first year since 2002 when predator management began at CBNS, Bandon Beach and New River, that productivity as measured by the number of fledglings per male was below the recovery goal of 1.00 (Table 13). The poor productivity of 2010 was also reflected in the overall fledging success rate which was the lowest since 2002, and the first time it was below the average since the implementation of predator management (Table 11). Despite the relatively low nest success (Table 7 and 11), the low productivity was not a result of poor nest success, as there was the highest number of broods ever monitored (Table 12) and the most number of chicks ever hatched. The poor productivity was due to poor fledging success. The reasons for the poor fledging success are very difficult to determine. Early in the season the weather was cool and wet, well into June, including a relatively strong winter like storm in the first week of June that certainly negatively impacted broods as well as nests. July had very strong northwest winds which lasted nearly three consecutive weeks. Yet August was relatively calm, warm, and at times foggy, but not necessarily extreme in any manner. Normally late season broods do much better than early season broods, but in 2010 many late season broods failed. At Tenmile, seven of the last 10 broods failed, at Bandon Beach, five of the last eight broods failed, and at New River all seven of the last broods failed. This was a high level of brood failure for late in the season. We did not note higher levels of predator activity during these time periods, so we cannot conclusively say whether the brood failures were a result of predator activity. The widespread nature of the brood failures, as well as the poor productivity at most sites, suggests that the causes of poor productivity were not site specific, but were more likely caused by some widespread event. Snowy Plovers at other locations like Washington (Scott Pearson, pers. comm.), Humboldt Co., CA (Colwell *et al*. 2010), and the Monterey Bay area, CA (Gary Page, pers. comm.) also experienced poor productivity in 2010. We believe that the poor production was also not related to predator management strategies. Predator management activities were at the same basic levels or higher as previous years, and there is little data to suggest that predator management was not effective. While plover production was relatively poor, because 80 chicks were produced, with an average return rate of 45% (Table 2), we can expect to have about 36 hatch year 2010 plovers return in 2011. This level of returning hatch year birds may be enough to replace adults that do not survive the coming winter.

Productivity indices for all sites in 2010 were 16% and lower (Tables 14 –20), indicating that there was much effort by the plovers in terms of eggs laid, but poor productivity in terms of fledglings

produced. Low productivity indices were due to high numbers of eggs laid (partially due to high numbers of rodent and other depredations) and low numbers of fledglings (due to poor fledging success). While overall plover productivity in 2010 was generally poor, plover productivity at individual sites continues to be higher than previous to predator management (Tables 14-20). Overall mean fledging success has improved from 39% to 47% (Figure 13), although this difference is not significant. The mean number of fledglings per male has significantly improved from 1.06 to 1.31 (Figure 14). The overall productivity data has generally improved since the implementation of predator management, and we continue to recommend that predator management be funded, as this aspect of plover management is critical to increasing plover population.

Increased plover numbers lead to increased nest numbers and densities of nests. Higher densities of nests may attract predators. Plover nesting ecology entails cryptic nesting to avoid predators, so plovers have a tendency to disperse nests around available habitat. Plovers also tend to look for new places to nest when they repeatedly fail, as the plovers at CBNS have done in the past two years when they nest on South Beach after failing on the nesting areas. We have also documented plovers occupying new nesting habitat as it has become available at places like Overlook and the New River HRA. It should be expected that as the plover numbers increase within the current Oregon coastal range, that the plovers will begin to occupy stretches of beach adjacent to the current nesting areas. The plovers using Siltcoos and Overlook move between these sites repeatedly, and have been regularly noted roosting and feeding along the stretch of beach from Waxmyrtle trail to Carter Lake trail to North Overlook. In the past five years, there have been three nests and two broods that originated in the Carter Lake trail vicinity (Lauten *et al*. 2007, 2006, 20005, 2008,and 2009). In 2010, eight broods from Siltcoos to Overlook used or originated from this section of beach. This section of beach is contiguous plover habitat. The level of recreational activity along this section of beach is relatively low, resulting in undisturbed hours for plovers whether they are roosting, nesting or brooding. While recreational activity is relatively low, there are still day users, hikers and off leash dogs that use this section of beach, especially near the Carter Lake trailhead where there is good plover habitat. There are no signs or ropes along this section of beach, and the dry sand is not closed. With expanding plover populations in this area, and successful nesting at Siltcoos and Overlook, plovers should be expected to continue to use this area in the future. Better plover protection for this section of beach may need to be considered in the future.

Other examples of plovers expanding into newer areas include a nest found south of South Overlook near the Overlook Loop trail. This is the first time we have had a known nest between Overlook and Tahkenitch. In addition, at least two other broods used this section of beach, including one that moved south to Tahkenitch. At Tenmile there is regular use of the beaches north and south of the spits, with nesting and brood activity in these areas. At CBNS, a nest was found over a quarter mile north of the FAA towers, the first nest we have ever found north of the FAA towers. We have not surveyed the beach north of access point one at CBNS, between Horsefall Beach and the access point, but it is possible that sufficient habitat could exist for a pair to attempt to nest. At Bandon Beach, five nests were located below the parking lot at China Creek, including two on the north side of the creek. Agency managers should be aware that increasing plover densities are likely to lead to more plovers and nests being found in new locations, and once plovers are successful at these locations, they will likely attempt to nest there again in future seasons. Protection measures will likely need to be taken to prevent recreational conflicts.

Expansion and improvement of the nesting areas continues as the plover population has increased. In addition to annual maintenance at all sites, shell hash was spread at Siltcoos, North Overlook, and on the 95HRA at CBNS. Plovers responded by placing nearly 50% of the nests at these locations in shell hash. We continue to support any additional shell hash on any nesting area. We continue to recommend maintenance and expansion of all nesting areas, as they continue to provide the least disturbed and most protected places for plovers to nest. While several nesting areas on Forest Service land including Siltcoos

and South Tenmile are difficult to expand, other locations like South Overlook and North Tenmile have potential for additional improved habitat.

Staff dedicated to recreational monitoring and volunteers continue to help reduce violations and educate the public about plovers and dog related issues, and we recommend that these aspects of management continue and be funded. At Siltcoos and Bandon Beach where parking lots and recreational activities are adjacent to nesting plovers, monitoring by staff and volunteers is essential to improving plover success and reducing disturbance issues. The OPRD Habitat Conservation Plan (Jones and Stokes 2007) has been approved by the Park Commission and an MOU has been signed by cooperating land management agencies. Within the next two years, site management plans will be written and ultimately implemented that will restrict dogs from plover nesting beaches, limiting dog related disturbance.

We continue to document some violations occurring in the evenings and at night when parking areas are not monitored. One exclosed nest below the China Creek parking lot that was monitored daily by volunteers had its eggs mysteriously disappear between a Wednesday afternoon and a Thursday morning. Fireworks and beer cans were found in the parking lot on Thursday morning. There was no direct evidence as to whether the exclosure was entered by humans. This illustrates the potential vulnerability of exclosed nests near a high recreational area. We have recommended (Lauten *et al*. 2009) that a gate be considered to close the China Creek parking lot at night to help reduce violations. We realize there are technical issues with a gate however we believe a gate would significantly reduce illegal camping and recreational issues (such as fireworks and fires on the beach) at China Creek. We continue to recommend that Bandon Police Department be contacted to discuss the potential for patrolling the parking lot or closing and opening a gate.

We continue to support any efforts to improve habitat at Bandon Beach SNA including improving habitat along the foredune from the China Creek overwash area to the north end of the HRA by carving out scalloped shaped contours along the length of the beach and widening the foredune area. We continue to support all efforts to improve the HRA at Bandon Beach, and in addition improve degrading habitat on state land on the south side of the mouth of New River. Dune growth continues on the south spit of New River, and removal of these dunes will only become more expensive and difficult as they continue to expand. We are grateful to have permission from Michael Keiser to manage plovers on his property south of Bandon Beach SNA at New River, and we encourage any efforts to secure this land through management agreements with appropriate agencies if the opportunity arises. This area has been important for nesting and brooding plovers and any potential to enhance this area and manage recreational access from Lower Fourmile Road is worthwhile.

The BLM improved the north end of the New River HRA for the first time in three years and plans to continue habitat maintenance on a large portion of the HRA south of Croft Lake breach. The BLM HRA at New River continues to be a very important plover nesting area and we support all efforts to maintain and improve the area. Breaching did not occur in the winter of 2009 – 2010, but we continue to support any efforts to breach, as breaching creates some of the best grass free areas that remain grass free with little additional mechanical work. We recommend that signs be posted along the foredune north of the HRA as plovers continue to nest and brood in this area, and also at Clay Island breach where plovers have now nested two years consecutively.

In 2010 it appeared that the number of hikers traveling from the Coquille jetty area south along Bandon Beach and New River to Floras Lake was reduced. However, hiking still remains an issue, especially illegal camping and off leash dogs. Agency staff made efforts to improve signage about the coastal trail and plover related issues, and this work continues. Plans to erect more signs at more locations have been discussed. Agency personnel recognize that we will have to further modify the signs and

educate hikers once dogs are not permitted on plover beaches, and potential alternate routes may need to be planned for hikers with dogs.

We recommend the continued use at all sites of ropes and signs along nesting beaches and habitat restoration areas. Ropes and signs should be installed as early in the season as practical so that the closed sections of beach are adequately protected throughout the season and the public understands which sections of beach are closed and the message is consistent throughout the nesting season and from year to year. Installing ropes and signs at the beginning of the season also reduces the need to respond to individual nests that are within closed beach sections but not roped and signed. This reduces the disturbance to those nests when ropes and signs have to be installed after a nest is found.

Habitat Restoration and Development Projects

The USFS bulldozed 12 acres of habitat south of Holman Vista, Sutton Beach in the winter of 2009-10. Spreading small woody debris or shell hash on the areas may attract plovers as well as improve nesting potential.

At Siltcoos, six acres of grass was hand pulled on the north side and eight acres on the south side of the estuary were bulldozed in winter 2009-10. Shell hash was spread on six acres on the north side (100 cubic yards) and seven and half acres on the south side (100 cubic yards).

At Overlook 15 acres of habitat on the north side and 20 acres on the south side were bulldozed in winter 2009-10. Shell hash was spread on 15 acres (200 cubic yards).

At Tahkenitch, 12 acres of habitat was bulldozed in winter 2009-10.

At Tenmile, 10 acres on the north side and 23 acres on the south side were bulldozed in the winter of 2009-10.

At CBNS in winter 2009-10, BLM disked 148 acres of habitat restoration area and parts of the spoil. Shell hash (ca. 400 cubic yards) was spread on 30 additional acres on the 95HRA.

At Bandon Beach, there was no habitat work completed in winter 2009-10. Habitat maintenance is scheduled for winter 2010-11 including improvements in the foredune by scalloping one acre areas.

At New River, BLM bulldozed and improved 28 - 30 acres from the north end of the HRA to Croft Lake breach in winter 2009-10. For winter 2010-11, about 20 acres of habitat from south of Croft Lake breach to New Lake breach is scheduled for bulldozing and improvement. Additional work south of New Lake breach is scheduled for 2012.

Recommendations

Signing of Restricted Areas

Signing and roping for the 2011nesting season should again be implemented to inform the public of plover nesting habitat and direct the public away from the nesting areas. High tides early in the season often make posting areas a challenge, and while it is important to have signs in place beginning on 15 March, in areas where the ocean is regularly lapping against the foredune, sign should not be erected or placement should be delayed. Maintenance of signs is important to keep violations to a minimum. To

maximize the effectiveness of signs and ropes each site should continue to be evaluated and ways to improve the signing and ropes should be considered.

General Recommendations

Below are general recommendations. We also provide additional site-specific comments and management recommendations in Appendix B.

- Continue intensive breeding season monitoring and explore funding an additional monitor as plover numbers and nests have increased and approached goals established in the USFWS Recovery Plan for Snowy Plovers; continue monitoring plover populations and productivity to ensure recovery goals are maintained.
- Maintain, enhance and expand habitat restoration areas. Spread shell hash to enhance nesting substrate.
- Selectively use mini-exclosures in conjunction with predator management to reduce the risks to adult plovers, decrease the time monitors spend around individual nests, and decrease disturbance to plovers. Determine exclosure use dependent on predation pressure, density of plover nests, and nest locations.
- Coordinate with Wildlife Services if cameras are used to identify nest predators.
- Increase and/or maintain predator management at all sites and explore ways of better understanding the activity patterns and population levels of predators, particularly corvids. Fully fund three Wildlife Services employees.
- Continue to coordinate with federal agency employees regarding time frames of any habitat management work to be completed to minimize disturbance to nesting activity and broods.
- Coordinate agency activities in restricted/closed areas with plover biologists to minimize disturbance to nesting and brood rearing.
- Continue and explore ideas to document and monitor human disturbance by various recreational users in plover nesting areas.
- Continue to expand and refine volunteer efforts to monitor recreational use.
- Design educational programs to inform and educate the local communities and annual visitors about plover issues.
- Design informative/interactive presentations for school children.

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LITERATURE CITED

Burrell, M. 2010. Integrated Predator Damage Management Report for the Western Snowy Plover (*Charadrius alexandrinus nivosus*) 2010 Breeding Season. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, and the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes National Recreational Area, Reedsport.

Casler, B.R., C.E. Hallett, and M.A. Stern. 1993. Snowy Plover nesting and reproductive success along the Oregon coast - 1993. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, and the Coos Bay District Bureau of Land Management, Coos Bay.

Castelein, K.A., D.J. Lauten, R. Swift, and M.A. Stern. 1997. Snowy Plover distribution and reproductive success along the Oregon coast - 1997. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes National Recreational Area, Reedsport.

Castelein, K.A., D.J. Lauten, R. Swift, M.A. Stern, and K.J. Popper. 1998. Snowy Plover distribution and reproductive success along the Oregon coast - 1998. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes National Recreational Area, Reedsport.

Castelein, K.A., D.J.Lauten, K.J. Popper, J.A. Fukuda, and M.A. Stern. 2000a. Snowy Plover distribution and reproductive success along the Oregon coast – 1999. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Castelein, K.A., D.J.Lauten, K.J. Popper, D.C. Bailey, and M.A. Stern. 2000b. The distribution and reproductive success of the Western Snowy Plover along the Oregon Coast – 2000. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Castelein, K.A., D.J.Lauten, L.N. Renan, S.R. Pixley, and M.A. Stern. 2001. The distribution and reproductive success of the Western Snowy Plover along the Oregon Coast - 2001. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Castelein, K.A., D.J.Lauten, S.R. Pixley, L.N. Renan, M.A. Stern, and C. Grinnell. 2002. The distribution and reproductive success of the Western Snowy Plover along the Oregon Coast - 2002. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Colwell, M. A., C. B. Millett, J. J. Meyer, J. N. Hall, S. J. Hurley, S. E. McAllister,A. N. Transou, R. R. LeValley. 2005. Snowy Plover Reproductive Success in Beach and River Habitats. Journal of Field Ornithology, 4:373-382

Colwell, M.A., K.M. Brindock, N.S. Burrell, M.A. Hardy, J. J. Muir, S.A. Peterson, S.E. McAllister, K.G. Ross and R.R. LeValley. 2008. Final Report: 2008 Snowy Plover Breeding in Coastal Northern California, Recovery Unit 2. Unpublished report submitted to MRB Research, Inc.

Colwell, M.A., N.S. Burrell, M.A. Hardy, K. Kayano, J.J. Muir, W. J. Pearson, S. A. Peterson, K.A. Sesser, and R.R Thiem. 2009. Final report: 2009 Snowy Plover breeding in coastal northern California, Recovery Unit 2. Submitted to MRB Research, Inc., and California Department of Fish and Game.

Colwell, M.A., N.S. Burrell, M.A. Hardy, S.E. McAllister, W.J. Pearson, S.A. Peterson, K.G. Ross, and K.A. Sesser. 2010. Final report: 2010 Snowy Plover breeding in coastal northern California, Recovery Unit 2. Submitted to MRB Research, Inc.and California Department of Fish and Game.

Craig, D.P., M.A. Stern, K.A. Mingo, D.M. Craig, and G.A. Rosenberg. 1992. Reproductive Ecology of the Western Snowy Plover on the South Coast of Oregon, 1992. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, and the Coos Bay District Bureau of Land Management, Coos Bay.

Estelle, V.B., C.E. Hallett, M.R. Fisher and M.A. Stern. 1997. Snowy Plover distribution and reproductive success along the Oregon coast - 1996. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes National Recreational Area, Reedsport.

Hallett, C.E., B.R. Casler, M.A. Platt, M.A. Stern. 1994. Snowy Plover distribution and reproductive success along the Oregon coast - 1994. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, the Dunes National Recreation Area, Reedsport, and the Coos Bay District Bureau of Land Management, Coos Bay.

Hallett, C.E., B.R. Casler, M.A. Platt, M.A. Stern. 1995. Snowy Plover distribution and reproductive success along the Oregon coast - 1995. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, and the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes National Recreational Area, Reedsport.

Jones and Stokes. 2007. Habitat Conservation Plan for the Western Snowy Plover. September. (J&S 06537.06) Portland, OR. Prepared for U.S. Fish and Wildlife Service and Oregon Parks and Recreation Department.

Lauten, D.J., K.A. Castelein, B.V. Smithers, K.C. Jander, E. Elliot-Smith, and E.P. Gaines. 2003. The Distribution and Reproductive Success of the Western Snowy Plover Along the Oregon Coast – 2003. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland,

the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, E. Seckinger, E. Kolkemo, and E.P. Gaines. 2005. The Distribution and Reproductive Success of the Western Snowy Plover Along the Oregon Coast – 2004. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, E. Seckinger, and E.P. Gaines. 2006. The Distribution and Reproductive Success of the Western Snowy Plover Along the Oregon Coast – 2005. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, S. Weston, K. Eucken, and E.P. Gaines. 2006b. The Distribution and Reproductive Success of the Western Snowy Plover Along the Oregon Coast – 2006. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, Raya Pruner, Marvin Friel, and E.P. Gaines. 2007. The Distribution and Reproductive Success of the Western Snowy Plover Along the Oregon Coast – 2007. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, D.C. Bailey, T. Lewis, and E.P. Gaines. 2008. The Distribution and Reproductive Success of the Western Snowy Plover Along the Oregon Coast – 2008. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, J.D. Farrar, H.G. Herlyn, and E.P. Gaines. 2009. The Distribution and Reproductive Success of the Western Snowy Plover Along the Oregon Coast – 2009. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Mayfield, H.F. 1975. Suggestions for calculating nest success. Wilson Bulletin. 87:456-466.

Mayfield, H.F. 1961. Nesting success calculated from exposure. Wilson Bulletin. 73:255-261.

Murphy, R. K., I. M G. Michaud, D. R C. Prescott, J. S. Ivan, B. J. Anderson, and M. L. French-Pombier. 2003b. Predation on adult piping plovers at predator exclosure cages. Waterbirds 26:150–155.

Neuman, K. K, G. W. Page, L E. Stenzel, J. C. Warriner, and J. S. Warriner. 2004. Effect of Mammalian Predator Management on Snowy Plover Breeding Success. Waterbirds 27(3):257-263.

Page, G. W., L. E. Stenzel, D. W. Winkler, C. W. SwarthSource. 1983. Spacing out at Mono Lake: Breeding Success, Nest Density, and Predation in the Snowy Plover. The Auk, 100:13-24.

Page, G.W., L.E. Stenzel, W.D. Shuford, and C.R. Bruce. 1991. Distribution and abundance of the snowy plover on its western North American breeding grounds. J. Field Ornithol. 62:245-255.

Powell, A. N., C. L. Fritz, B. L. Peterson, J. M. Terp. 2002. Status of Breeding and Wintering Snowy Plovers in San Diego County, California, 1994-1999. Journal of Field Ornithology, 73:156-165.

Sandercock, B.K. 2003. Estimation of survival rates for wader populations: a review of mark recapture methods. Wader Study Group Bulletin. 100:163-174

Stern, M.A., J.S. McIver, and G.A. Rosenberg. 1990. Investigations of the western Snowy Plover at the Coos Bay North Spit and adjacent sites in Coos and Curry Counties, 1990. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, Oregon.

Stern, M.A., J.S. McIver, and G.A. Rosenberg. 1991. Nesting and reproductive success of the Snowy Plovers along the south Oregon coast, 1991. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland and the Coos Bay District Bureau of Land Management, Coos Bay

U.S. Fish and Wildlife Service. 1993. Final rule. Endangered and threatened wildlife and plants; Determination of threatened status for the Pacific coast population of the western snowy plover. Federal Register 58 FR 12864 03/05/93.

U.S. Fish and Wildfife Service. 2006. Endangered and threatened wildlife and plants: Proposed special rule pursuant to Section 4(d) of the Endangered Species Act for the Pacific coast distince population segment of the Western Snowy Plover. Federal Register 71(77): 20625-20636.

U.S. Fish and Wildlife Service. 2007. Recovery Plan for the Pacific Coast Population of the Western Snowy Plover (*Charadrius alexandrinus nivosus*). In two volumes. Sacramento, California. xiv + 751pp.

Table 1. Population estimates of the Western Snowy Plover on the Oregon Coast, 1990-2010. For Window Survey, first number is counted plovers minus duplicate band combos and unidentified plovers, number in parenthesis is total head count without considering duplicate combos or unknown plovers.

YEAR	WINDOW SURVEY	# SNPL BREEDING	# SNPL PRESENT
1990	59	-	-
1991	35	-	-
1992	28	-	-
1993	45	55-61	72
1994	51	67	83
1995	64 (67)	94	120
1996	85	110-113	134-137
1997	73 (77)	106-110	141
1998	57 (59)	75	97
1999	49 (51)	77	95-96
2000	NC	89	109
2001	71 (85)	79-80	111-113
2002	71 (76)	80	99-102
2003	63	93	102-107
2004	82 (83)	120	136-142
2005	100	104	153-158
2006	91	135	177-179
2007	125	162	181-184
2008	98-105	129	188-200
2009	136-143 (139-146)	149-150	199-206
2010	158	175	232-236

Table 2. Number of Snowy Plover fledglings, number of previous year fledglings returning, return rate, number nesting, and percent nesting in first year of return along the Oregon coast, 1990 - 2010.

Year	# of Fledglings	# of HY birds from previous year sighted on OR coast	Return Rate (#HY/#Fled)	# that nested on OR coast	% nested on OR coast
2010	80	54	50%	38	70%
2009	107	35	48%	26	74%
2008	73	52	42%	27	52%
2007	124	32	29%	26	81%
2006	110	29	37%	23	79%
2005	78	43	40%	33	77%
2004	108	26	43%	21	81%
2003	60	14	45%	14	100%
2002	31	18	56%	15	83%
2001	32	23	53%	14	61%
2000	43	31	58%	25	81%
1999	53	18	56%	12	67%
1998	32	14	34%	11	79%
1997	41	30	64%	18	60%
1996	47	18	32%	10	55%
1995	57	37	66%	13	35%
1994	56	16	44%	8	50%
1993	36	10	30%	6	60%
1992	33	6*	38%	2	33%
1991	16	No chicks banded in 1990			
1990	3	x	x		

* - minimum number sighted

Average return rate = 45.5%
SD = 11.1%
Average percent of returning HY birds that nest in first season = 67.3%
SD = 17.2%

Table 3. Number of Adult Snowy Plovers at each nesting area on the Oregon Coast, 2010. First number is number of adults recorded at each site, and the second number is the number of breeding adults recorded at each site.

	Sutton	**Siltcoos Total**	**Overlook Total**	**N Tahkenitch**	**Tenmile Total**	**CBNS**	**New River/Bandon/Floras Lake Total**
# of banded females/# nested	2/1	24/10	28/12	8/3	39/14	33/17	32/18
# of unbanded females/# nested	0	3/3	2-3/2	1/1	2-4/0	4-5/4	9/8
# of banded males/# nested	1/1	20/10	27/14	5/3	25/18	35/17	32/27
# of unbanded males/# nested	0	1/0	1/0	0/0	1/1	3/1	2/1
Total	3/2	48/23	58-59/28	14/7	67-69/33	75-76/39	75/54

12/21/10

Table 4. Total number of nests for all sites on the Oregon Coast 1990 – 2010 cells tally nests only and not broods from undiscovered nests. The number of broods from undiscovered nests is totaled for each year and site only.

Site Name	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	Tot nst	Totbrd[a]
NEC													1	0	0	0	0	0	0			1	1
SU				2	1	2	6	14	8	3	7	15	3	1	0	0	4	3	0	0	1	70	1
NSIU													1	0	0	0	0	0	0			1	0
SI:																							
North				0	2	4	2	0	1	4	8	0	0	0	7	8	12	15	30	14	17	124	0
South				1	2	2	1	3	3	17	14	14	10	7	4	9	13	13	6	9	24	152	3
OV:																							
North										2	8	12	5	7	11	11	9	13	14	9	21	122	3
South										0	0	3	3	1	3	5	1	3	1	5	16	41	1
TA																							
North				0	0	0	0	0	0	0	4	7	8	13	8	11	4	10	5	6	7	83	1
South				0	3	9	18	14	6	3	1	6	7	1	0	0	0	0	0			68	2
3mileCr/ Umpqua R				0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0			1	0
TM:																							
North					2	2	1	0	0	0	1	2	3	5	9	6	10	20	12	13	13	99	3
South	2	0	9	8	5	4	3	2	11	5	5	6	9	12	8	11	12	21	16	41	30	220	7
CBNS:																							
SB	0	4	6	3	4	3	3	6	6	0	1	1	2	3	2	4	0	8	5	19	17	97	12
SS	20	9	4	6	9	12	22	14	5	2	5	3	2	9	8	9	14	12	18	16	14	213	13
NS	5	1	1	0	0	0																7	0
HRAs					4	3	2	3	7	12	22	13	15	11	16	16	18	19	26	30	33	250	20
Anad. Sp	0																					0	1
Menasha	1	0																				1	0
BB	0	14	8	10	5	9	3	4	1	2	2	6	5	5	17	31	23	30	28	31	26	260	6
NR	6	6	2	0	6	20	18	25	26	28	17	23	14	16	24	23	27	35	35	40	42	433	12
FL	2	2	6	11	8	6	9	8	4	0	5	0	1	0	0	0	0	0	0	3	0	65	3
Tot nst	**36**	**36**	**36**	**41**	**51**	**76**	**89**	**93**	**78**	**78**	**100**	**111**	**89**	**91**	**117**	**144**	**147**	**202**	**196**	**236**	**261**	**2308**	
Tot brd[a]	**2**	**1**	**5**	**7**	**4**	**6**	**11**	**5**	**3**	**1**	**2**	**0**	**1**	**4**	**2**	**3**	**15**	**4**	**3**	**8**	**2**		**89**

[a] – broods from undiscovered nests only; these broods are not tallied in the total number of nests

NEC – Necanicum, SU – Sutton, NSIU – N Siuslaw, SI – Siltcoos, OV – Overlook, TA – Tahkenitch, TM – Tenmile, CBNS – Coos Bay North Spit (SB - South Beach, SS – South Spoil, NS – North Spoil), BB – Bandon Beach, NR – New River, FL – Floras Lake

Table 5. Nest Success (Mayfield Method) of Snowy Plovers on the Oregon coast, 1990-2010.

Year	All nests (%)[a]	Exclosed (%)[b]	Not Exclosed (%)[b]	N[a]	N[b]
1990	13	[c]	13	36	29
1991	20	77	5	36	33
1992	55	79	9	36	34
1993	56	77	16	41	39
1994	72	75	68	51	47
1995	41	62	7	76	70
1996	47	66	7	89	87
1997	40	52	26	93	87
1998	52	70	15	78	70
1999	54	62	40	78	72
2000	31	46	2	100	91
2001	26	67	4	111	101
2002	38	67	13	89	76
2003	43	79	23	91	79
2004	56	86	20	117	109
2005	45	70	27	144	128
2006	38	60	40	147	126
2007	33	66	41	202	159
2008	30	45	38	196	159
2009	23	72	28	236	184
2010	25	67	30	261	206
Average 1990-2010	39.90	67.25	22.48		
STDEV 1990-2010	14.60	10.77	16.43		

[a] - Overall includes exclosed nests, unexclosed nests, infertile nests, and nests with one egg that were subsequently abandoned.

[b] - Does not include infertile nests, nests with one egg that were subsequently abandoned, nest found failed, or nest never clearly active because the outcome of these nests was not affected by the presence or absence of an exclosure.

Table 6. Apparent nest success of Snowy Plovers on the Oregon Coast, 2010.

		Nests Exclosed			Nests Not Exclosed			Exclosed Nests	Nests Not Exclosed	
Site	**Total #**	**Hatch**	**Fail**	**Unknown**	**Hatch**	**Fail**	**Unknown**	**App Nest Success**	**App Nest Success**	**Overall Nest Success**
Sutton	1	-	-		-	1		-	0%	0%
Siltcoos										
North	17	0	0		7	10		-	41%	41%
South	24	6	0		0	18		100%	0%	33%
Combined	41	6	0		7	28		100%	25%	32%
Overlook										
North	21	0	0		13	8		-	62%	62%
South	16	0	0		3	13		-	19%	19%
Combined	37	0	0		16	21		-	43%	43%
N Tahkenitch	7	0	0		3	4		-	43%	43%
Tenmile										
North	13	4	1		0	8		80%	0%	31%
South	30	13	3		1	13		81%	7%	47%
Combined	43	17	4		1	21		81%	5%	42%
CBNS										
South Beach	17	0	0		9	8		-	53%	53%
South Spoil	14	0	0		2	12		-	14%	14%
HRAs	33	0	0		5	28		-	15%	15%
Combined	64	0	0		16	48		-	25%	25%
Bandon	26	11	2		0	13		85%	0%	42%
New River										
HRA	27	9	7	2	1	8		50%	11%	37%
Other Lands	15	4	5		1	5		44%	17%	33%
Combined	42	13	12	2	2	13		48%	13%	36%
Floras Lake	0	-	-		-	-		-	-	-
Totals	261	47	18	2	45	149		72%	23%	35%

Table 7. Apparent nest success of exclosed and unexclosed Snowy Plover nests on the Oregon coast, 1990 - 2010.

Year	All nests (%)	Exclosed (%)	Not Exclosed (%)
1990	31	*	28
1991	33	75	9
1992	67	85	11
1993	68	83	27
1994	75	80	71
1995	50	65	5
1996	56	71	10
1997	48	58	14
1998	56	72	8
1999	56	64	0
2000	38	48	0
2001	35	68	0
2002	44	66	6
2003	51	77	9
2004	62	85	8
2005	48	72	14
2006	47	66	32
2007	42	71	35
2008	34	49	30
2009	33	76	25
2010	35	72	23
Average =	48.05	70.15	17.38
STDEV =	12.88	10.28	16.55

* Multiple experimental designs used, data not included

Table 8. Causes of Snowy Plover nest failure at survey sites along the Oregon coast, 2010.

Site Name	Tot Nsts	# Fail	Depredations					Other					
			Corvid	Unk	Mam-mal	Rodent	Adult plover	Wind/Wea-ther	Abandon	One Egg Nest	Over-wash	Infer	Unk cause
Sutton	1	1							1				
Siltcoos:													
North	17	10		1				2	2	3			2
South	24	18	1	2		2		1	2	2	1	1	6
Overlook													
North	21	8							2	3		1	2
South	16	13	1					1	2	6	1		2
N Tahkenitch	7	4								3		1	
Tenmile:													
North	13	9	1	3				1	1	1			2
South	30	16	2	6	1 [a]	1		1	2	2			1
Coos Bay North Spit:													
South Beach	17	8		4				1	1				2
South Spoil	14	12		5	1 [b]	4			1	1			
HRAs	33	28		11		14			2	1			
Bandon	26	15	2	3		1			1				8
New River	42	25	1	5	5 [c]	1	1	2	3	3	1		3
TOTALS	**261**	**167**	8	40	7	23	1	9	20	25	3	3	28

[a] – skunk depredation

[b] – coyote depredation

[c] – 2 skunk depredations, 1 raccoon depredation, 2 unknown mammalian depredation

Table 9. Cause of failure for Snowy Plover nests protected by predator exclosures and nests unprotected by predator exclosures along the Oregon coast, 2010.

Cause of Failure		Exclosed	Unexclosed	Totals
Egg Depredation	**Corvid**		8	8
	Unknown	1	39	40
	Rodent	1	22	23
	Raccoon		1	1
	Canine		1	1
	Skunk	2	1	3
	Unknown Mammal		2	2
Depredation	**Adult Plover**	1		1
Other	**Wind/Weather**	3	6	9
	Overwashed	1	2	3
	Infertile		3	3
	One Egg Nests		25	25
	Abandoned	7	13	20
	Unknown Cause	2	26	28
Totals		18	149	167

Table 10. Total number of young fledged for all sites on the Oregon Coast 1990-2010 includes fledglings from broods from undiscovered nests.

Site Name	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	Tot
NEC											1	0	0	0	0	0	0	0	0			1
SU				0	0	0	0	1	1	0	3	0	0	0	0	0	0	0	0			5
NSIU													0	0	0	0	0	0	0			0
SI:																						
North					0	0	0	0	2	4	0	0	0	0	7	2	11	7	5	8	4	50
South				0	1	2	0	0	4	2	7	0	0	2	5	7	7	4	3	11	4	59
OV:																						
North										3	5	1	2	3	3	5	8	12	3	7	11	63
South										0	0	1	0	0	3	2	0	1	0	2	7	16
TA:																						
North				0	0	0	0	0	0	0	2	4	1	3	6	8	5	2	0	1	2	34
South				0	1	12	8	7	1	1	3	4	5	2	0	0	0	0	0			44
TM:																						
North					0	1	0	0	0	0	0	0	3	1	3	6	12	13	3	2	3	47
South	0	0	14	7	3	3	4	4	3	7	5	4	3	9	9	5	7	14	6	19	12	138
CBNS:																						
SS	3	2	4	13	17	17	22	8	6	5	3	4	2	7	13	9	11	7	17	4	2	176
SB	0	11	9	2	6	2	2	7	2	0	0	1	1	3	0	8	1	10	7	17	13	102
HRAs					7	2	1	1	1	23	6	6	8	14	22	6	19	9	16	10	4	155
BB	0	1	1	3	5	1	1	0	1	1	0	1	0	4	16	11	12	13	2	6	6	85
NR	0	0	4	0	7	12	8	9	11	8	5	6	6	12	21	9	17	32	11	20	12	210
FL	0	2	2	11	9	6	1	4	0	0	3	0	0	0	0	0	0	0	0	0	0	38
Total	**3**	**16**	**34**	**36**	**56**	**58**	**47**	**41**	**32**	**54**	**43**	**32**	**31**	**60**	**108**	**78**	**110**	**124**	**73**	**107[a]**	**80**	**1223**

[a] – adjusted from 106 to 107 based on hatch year returns

Table 11. Overall Mayfield nest success, fledging success and total number of fledglings on the Oregon Coast, 1990 – 2010.

Year	% Nest Success[a]	% Fledging Success[b]	# Fledglings[c]
1990	13	11	3
1991	20	45	16
1992	55	41	33
1993	56	42	36
1994	72	50	56
1995	41	50	57
1996	47	32	47
1997	40	30	40
1998	52	26	32
1999	54	43	54
2000	31	41	43
2001	26	34	32
2002	38	29	31
2003	43	47	60
2004	56	55	108
2005	45	41	78
2006	38	48	110
2007	33	54	123
2008	30	47	73
2009	23	50	106
2010	25	33	80
	Mean = 39.9 $\pm$ 14.6	Overall = 40.4 $\pm$ 10.8	Total = 1222

a – Overall Mayfield Success from Table 5

b – does not include fledglings from broods from undiscovered nests

c – total number of fledglings including from broods from undiscovered nests

Table 12. Fledgling success, brood success, and number of fledglings per male for Snowy Plovers on the Oregon Coast, 2010.

Site Name	Total # Broods*	% Brood Success*	Total # Eggs Hatched	Min. # Fledged		% Fledgling Success**	# of Breeding Males[a]	# of Fledglings/ Male	# of Fledglings/Male – Combined[c]
				From Known Nests	From Undiscovered Nests				
Sutton	0	-	-	-	-	-	-	-	-
Siltcoos:									
North Siltcoos	7	43%	17	4		24%	5	0.80	0.80 (10)
South Siltcoos	6	67%	13	4		31%	5	0.80	
Overlook									
North Overlook	14	50%	31	9	2	29%	10	1.10	1.29 (14)
South Overlook	4	100%	8	6	1	75%	4	1.75	
North Tahkenitch	3	67%	7	2		29%	3	0.67	0.67 (3)
Tenmile:									
North Spit	4	25%	10	3		30%	4	0.75	0.83 (18)
South Spit	14	57%	41	12		29%	15	0.80	
Coos Bay N. Spit									
South Spoil	2	100%	5	2		40%	3	0.67	
South Beach	9	78%	22	13		59%	9	1.44	1.12 (17)
HRA	5	60%	13	4		31%	5	0.80	
Bandon	11	36%	31	6		19%	8	0.75	0.75 (8)
New River									
HRA	10	70%	24	12		50%	15	0.80	0.60 (20)
Other lands	5	0%	12	0		0%	7	0.00	
TOTALS**	**94**	**55%**	**234**	**77**	**3**	**33%**	**87**	**0.92**	
TOTAL FLEDGED				**80**					

% Brood success = # broods with at least 1 chick fledged / total # of broods

% Fledging Success = # of young fledged / # of eggs hatched

* Includes broods from undiscovered nests:

** Does not include fledglings from undiscovered nests because we do not know how many eggs hatched from those nests.

[a] – number of known individual breeding males for each site

[b] – number of known breeding males in entire population; this is not a tally of known males from each site as some males may have nested at more than one location

[c] – number of fledglings for both sites combined and number of known individual breeding males for both sites combined Sample size of males in parenthesis.

Table 13. Overall productivity of male Snowy Plovers along the Oregon coast, 1992-2010. Productivity is measured as number of fledglings per male.

Year	Mean	n	Min	Max	std
1992	1.250	20	0	4	1.164
1993	1.000	17	0	3	1.000
1994	1.483	29	0	5	1.353
1995	1.194	36	0	4	1.167
1996	0.881	42	0	3	0.942
1997	0.833	36	0	3	0.845
1998	0.833	36	0	3	0.971
1999	1.268	41	0	5	1.323
2000	0.973	37	0	5	1.190
2001	0.842	38	0	3	0.855
2002	0.700	40	0	3	0.939
2003	1.061	49	0	4	1.107
2004	1.645	62	0	5	1.161
2005	1.259	58	0	3	1.036
2006	1.559	68	0	4	0.983
2007	1.494	77	0	4	1.131
2008	1.060	67	0	4	1.028
2009	1.288	80	0	4	1.021
2010	0.875	88	0	4	1.004

Average = 1.132 STDEV = 0.279623
STERROR = 0.06415

Average pre pred mang = 1.056 STDEV = 0.228418876
STERROR = 0.072232391

Average post pred mang = 1.311 STDEV = 0.277770256
STERROR = 0.104987289

Table 14. Productivity of Snowy Plovers at Siltcoos, Lane Co., Oregon coast, 1993-2010.
Number of eggs laid, number hatched, hatch rate, # fledged, fledging success rate, and productivity index based on all known nests. Number of fledglings per male based on nests with known adult males only, therefore number of fledglings may vary from total number of fledglings.

Siltcoos	total # eggs laid	total # hatched	hatch rate	total # fledged	fledging success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/ male
2010	105	30	29%	8	27%	8%	8	10	0.80
2009	54	28	52%	17	61%	31%	17	11	1.55
2008	68	22	32%	8	36%	12%	8	9	0.88
2007	67	24	36%	11	46%	16%	11	10	1.10
2006	60	22	37%	13	60%	22%	11	5	2.20
2005	44	17	39%	9	53%	20%	9	7	1.29
2004	31	18	58%	12	67%	39%	12	5	2.40
2003	16	5	31%	2	40%	13%	2	4	0.50
2002	28	8	29%	0	0%	0%	0	2	0.00
2001	33	1	3%	0	0%	0%	0	3	0.00
2000	55	19	35%	7	37%	13%	7	8	0.88
1999	59	21	36%	6	29%	10%	6	8	0.75
1998	10	10	100%	6	60%	60%	6	3	2.00
1997	8	4	50%	0	0%	0%	0	2	0.00
1996	7	3	43%	0	0%	0%	0	1	0.00
1995	12	6	50%	2	33%	17%	2	3	0.67
1994	9	4	44%	1	25%	11%	1	3	0.33
1993	1	0	0%	0	0%	0%	0	0	0.00
total before predator management (1993-2003)	238	81	38.3+/-26.5	24	20.4+/-21.4	11.3+/-17.5	24	37	0.47+/-0.61
total after predator management (2004-2010)	429	161	40.4+/-10.6	78	50.0+/-14.5	21.1+/-10.8	78	57	1.46+/-0.63

[a] - productivity index = number of fledglings/number of eggs laid

Table 15. Productivity of Snowy Plovers at Overlook, Douglas Co., Oregon coast, 1999-2010

Number of eggs laid, number hatched, hatch rate, # fledged, fledging success rate, and productivity index based on all known nests. Number of fledglings per male based on nests with known adult males only, therefore number of fledglings may vary from total number of fledglings.

Overlook	total # eggs laid	total # hatched	hatch rate	total # fledged	fledging success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/ male
2010	92	39	42%	15	38%	16%	15	15	1.00
2009	31	14	45%	9	64%	29%	9	5	1.80
2008	34	5	18%	2	40%	6%	2	3	0.67
2007	46	19	41%	11	58%	24%	11	9	1.22
2006	28	18	64%	8	44%	29%	8	4	2.00
2005	42	16	38%	7	44%	17%	7	5	1.40
2004	39	14	36%	6	43%	15%	6	6	1.00
2003	17	9	53%	3	33%	18%	3	4	0.75
2002	24	13	54%	2	15%	8%	2	4	0.50
2001	39	10	26%	2	20%	5%	2	4	0.50
2000	22	8	36%	5	63%	23%	5	7	0.71
1999	6	6	100%	3	50%	50%	3	2	1.50
total before predator management (1999-2003)	108	46	53.8+/-28.4	15	36.2+/-20.2	20.8+/-17.9	15	21	0.79+/-0.41
total after predator management (2004-2010)	312	47	40.6+/-13.6	58	47.3+/-9.8	19.4+/-8.4	58	47	1.29+/-0.47

[a] - productivity index = number of fledglings/number of eggs laid

Table 16. Productivity of Snowy Plovers at Tahkenitch, Douglas Co., Oregon coast, 1993-2010.
Number of eggs laid, number hatched, hatch rate, # fledged, fledging success rate, and productivity index based on all known nests. Number of fledglings per male based on nests with known adult males only, therefore number of fledglings may vary from total number of fledglings.

Tahkenitch	total # eggs laid	total # hatched	hatch rate	total # fledged	fledging success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/ male
2010	14	7	50%	2	29%	14%	2	3	0.67
2009	13	6	46%	1	17%	8%	1	2	0.50
2008	14	0	0%	0	0%	0%	0	1	0.00
2007	23	6	26%	2	33%	9%	2	4	0.50
2006	12	9	75%	4	44%	33%	4	3	1.33
2005	26	14	54%	8	57%	31%	8	4	2.00
2004	21	14	67%	6	43%	29%	6	5	1.20
2003	37	17	46%	3	18%	8%	3	10	0.30
2002	30	16	53%	6	38%	20%	6	5	1.20
2001	36	22	61%	8	36%	22%	8	8	1.00
2000	15	6	40%	5	83%	33%	5	2	2.50
1999	9	1	11%	1	100%	11%	1	2	0.50
1998	18	11	61%	1	9%	6%	1	4	0.25
1997	41	10	24%	6	60%	15%	6	7	0.86
1996	51	21	41%	8	38%	16%	8	9	0.89
1995	21	16	76%	12	75%	57%	12	7	1.71
1994	9	8	89%	1	13%	11%	1	3	0.33
1993	0	0	0%	0	0%	0%	0	0	0.00
total before predator management (1993-2003)	267	128	45.6+/-26.7	51	42.7+/-32.8	18.1+/-15.6	51	57	0.87+/-0.73
total after predator management (2004-2010)	123	56	45.4+/-25.4	21	31.9+/-18.9	17.7+/-13.1	21	19	0.89+/-0.67

[a] - productivity index = number of fledglings/number of eggs laid

Table 17. Productivity of Snowy Plovers at Tenmile, Coos Co., Oregon coast, 1992-2010.

Number of eggs laid, number hatched, hatch rate, # fledged, fledging success rate, and productivity index based on all known nests. Number of fledglings per male based on nests with known adult males only, therefore number of fledglings may vary from total number of fledglings.

Tenmile	total # eggs laid	total # hatched	hatch rate	total # fledged	fledging success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/ male
2010	113	51	45%	15	29%	13%	15	18	0.83
2009	117	27	23%	16	59%	14%	16	9	1.78
2008	77	21	27%	8	38%	10%	8	8	1.00
2007	89	43	48%	27	63%	30%	27	19	1.42
2006	59	28	47%	16	57%	27%	16	10	1.60
2005	49	21	43%	8	38%	16%	8	8	1.00
2004	50	29	58%	12	41%	24%	12	9	1.33
2003	43	20	47%	10	50%	23%	10	8	1.25
2002	32	14	44%	3	21%	9%	3	8	0.38
2001	24	10	42%	4	40%	17%	4	4	1.00
2000	18	14	78%	5	36%	28%	5	4	1.25
1999	13	8	62%	7	88%	54%	7	3	2.33
1998	20	8	40%	3	38%	15%	3	4	0.75
1997	6	6	100%	4	67%	67%	4	2	2.00
1996	11	6	55%	4	67%	36%	4	4	1.00
1995	13	11	85%	2	18%	15%	2	4	0.50
1994	18	3	17%	3	100%	17%	3	2	1.50
1993	24	15	63%	5	33%	21%	5	5	1.00
1992	27	19	70%	14	74%	52%	14	7	2.00
total before predator management (1992-2003)	249	134	58.6+/-22.7	64	52.7+/-26.3	29.5+/-18.6	64	55	1.25+/-0.61
total after predator management (2004-2010)	554	220	41.6+/-12.3	102	46.4+/-13.0	19.1+/-7.8	102	82	1.28+/-0.32

Table 18. Productivity of Snowy Plovers at Coos Bay North Spit, Coos Co., Oregon coast, 1992-2010.
Number of eggs laid, number hatched, hatch rate, # fledged, fledging success rate, and productivity index based on all known nests. Number of fledglings per male based on nests with known adult males only, therefore number of fledglings may vary from total number of fledglings.

CBNS	total # eggs laid	total # hatched	hatch rate	total # fledged	fledging success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/ male
2010	160	40	25%	19	48%	12%	19	17	1.12
2009	171	58	34%	28	48%	16%	28	22	1.27
2008	125	63	50%	40	63%	32%	38	19	2.00
2007	108	45	42%	26	58%	24%	26	12	2.17
2006	86	54	63%	22	41%	26%	22	14	1.57
2005	80	38	48%	23	61%	29%	21	12	1.75
2004	73	42	58%	31	74%	42%	31	15	2.06
2003	57	29	51%	21	72%	37%	20	9	2.22
2002	48	21	44%	11	52%	23%	11	10	2.22
2001	49	21	43%	11	52%	22%	11	8	1.38
2000	75	23	31%	9	39%	12%	9	6	1.50
1999	38	35	92%	26	74%	68%	26	10	2.60
1998	49	18	37%	9	50%	18%	9	8	1.13
1997	64	32	50%	12	38%	19%	12	11	1.09
1996	77	48	62%	20	42%	26%	17	14	1.21
1995	53	35	66%	20	57%	38%	19	11	1.72
1994	50	44	88%	29	66%	58%	28	12	2.33
1993	26	18	69%	9	50%	35%	9	7	1.29
1992	32	21	66%	9	43%	28%	9	7	1.29
total before predator management (1992-2001)	513	295	60.4+/-20.3	154	51.1+/-11.8	32.4+/-18.1	149	94	1.55+/-0.52
total after predator management (2002-2010)	908	390	46.1+/-11.6	221	57.4+/-11.2	26.7+/-9.5	216	131	1.82+/-0.42

[a] - productivity index = number of fledglings/number of eggs laid

Table 19. Productivity of Snowy Plovers at Bandon Beach, Coos Co., Oregon coast, 1992-2010.

Number of eggs laid, number hatched, hatch rate, # fledged, fledging success rate, and productivity index based on all known nests. Number of fledglings per male based on nests with known adult males only, therefore number of fledglings may vary from total number of fledglings.

Bandon Beach	total # eggs laid	total # hatched	hatch rate	total # fledged	fledging success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/ male
2010	60	31	52%	6	19%	10%	6	8	0.75
2009	70	12	17%	6	50%	9%	6	8	0.75
2008	68	5	7%	2	40%	3%	2	11	0.18
2007	73	24	33%	13	54%	18%	13	8	1.63
2006	53	19	36%	8	42%	15%	7	6	1.16
2005	83	37	46%	11	30%	13%	11	12	0.92
2004	50	33	66%	15	45%	30%	14	10	1.40
2003	13	6	46%	2	33%	15%	2	4	0.50
2002	10	0	0%	0	0%	0%	0	2	0.00
2001	13	6	46%	1	17%	8%	1	3	0.33
2000	6	0	0%	0	0%	0%	0	2	0.00
1999	4	3	75%	1	33%	25%	1	2	0.50
1998	3	0	0%	0	0%	0%	0	1	0.00
1997	12	0	0%	0	0%	0%	0	2	0.00
1996	9	6	67%	1	17%	11%	1	2	0.50
1995	22	4	18%	0	0%	0%	0	3	0.00
1994	15	15	100%	5	33%	33%	5	4	1.25
1993	21	10	48%	3	30%	14%	3	5	0.60
1992	23	7	30%	1	14%	4%	1	4	0.25
total before predator management (1992-2001)	128	51	38.4+/-35.0	12	14.4+/-14.1	9.5+/-11.6	12	28	0.34+/-0.40
total after predator management (2002-2010)	480	167	33.7+/-21.8	63	34.8+/-16.8	12.6+/-8.8	55	69	0.81+/-0.54

[a] - productivity index = number of fledglings/number of eggs laid

Table 20. Productivity of Snowy Plovers at New River, Coos Co., Oregon coast, 1992-2010.

Number of eggs laid, number hatched, hatch rate, # fledged, fledging success rate, and productivity index based on all known nests. Number of fledglings per male based on nests with known adult males only, therefore number of fledglings may vary from total number of fledglings.

New River	total # eggs laid	total # hatched	hatch rate	total # fledged	fledging success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/ male
2010	107	36	34%	12	33%	11%	12	20	0.60
2009	109	49	45%	19	39%	17%	19	18	1.06
2008	92	34	40%	10	29%	11%	10	18	0.56
2007	96	47	49%	30	64%	31%	29	17	1.70
2006	69	34	49%	16	47%	23%	16	12	1.33
2005	63	36	57%	9	26%	14%	9	10	0.90
2004	70	37	53%	21	57%	30%	21	12	1.75
2003	44	25	57%	12	48%	27%	12	10	1.20
2002	39	17	44%	6	35%	15%	6	9	0.67
2001	53	22	42%	6	27%	11%	6	8	0.75
2000	46	14	30%	5	36%	11%	5	8	0.63
1999	74	42	57%	8	19%	11%	8	14	0.57
1998	73	60	82%	11	18%	15%	11	16	0.69
1997	65	41	63%	8	20%	12%	8	12	0.67
1996	54	41	76%	7	17%	13%	7	12	0.58
1995	48	12	25%	8	67%	17%	8	8	1.00
1994	18	14	78%	6	43%	33%	5	5	1.00
1993	0	0	0%	0	0%	0%	0	0	0.00
1992	6	6	100%	1	17%	17%	1	2	0.50
total before predator management (1992-2001)	437	252	55.3+/-30.8	60	26.4+/-18.4	14+/-8.2	59	85	0.64+/-0.28
total after predator management (2002-2010)	689	315	47.6+/-7.7	135	42.0+/-12.9	19.9+/-8.0	134	126	1.09+/-0.45

[a] - productivity index = number of fledglings/number of eggs laid

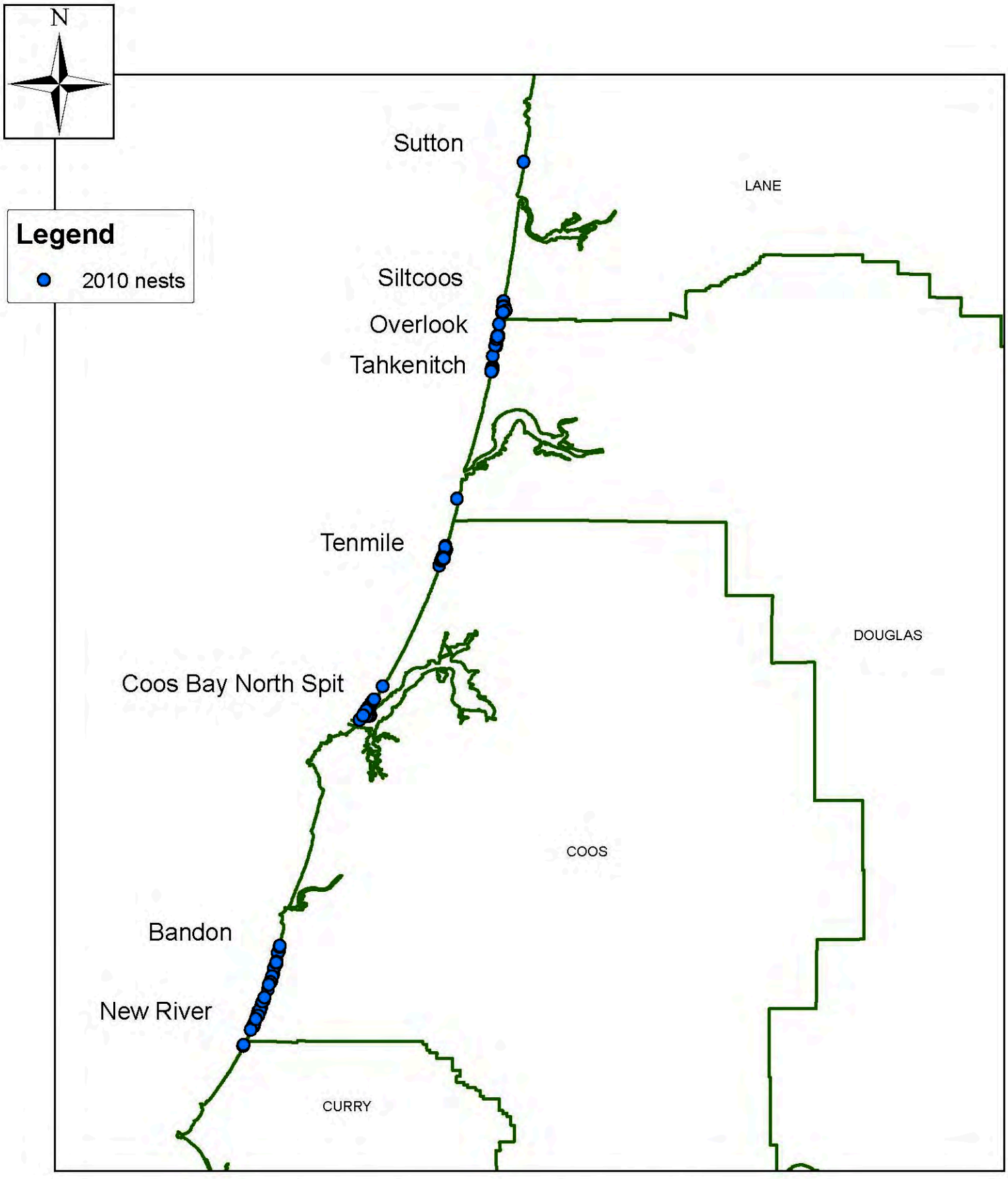


Figure 1. Snowy Plover nest locations along the Oregon Coast, 2010.

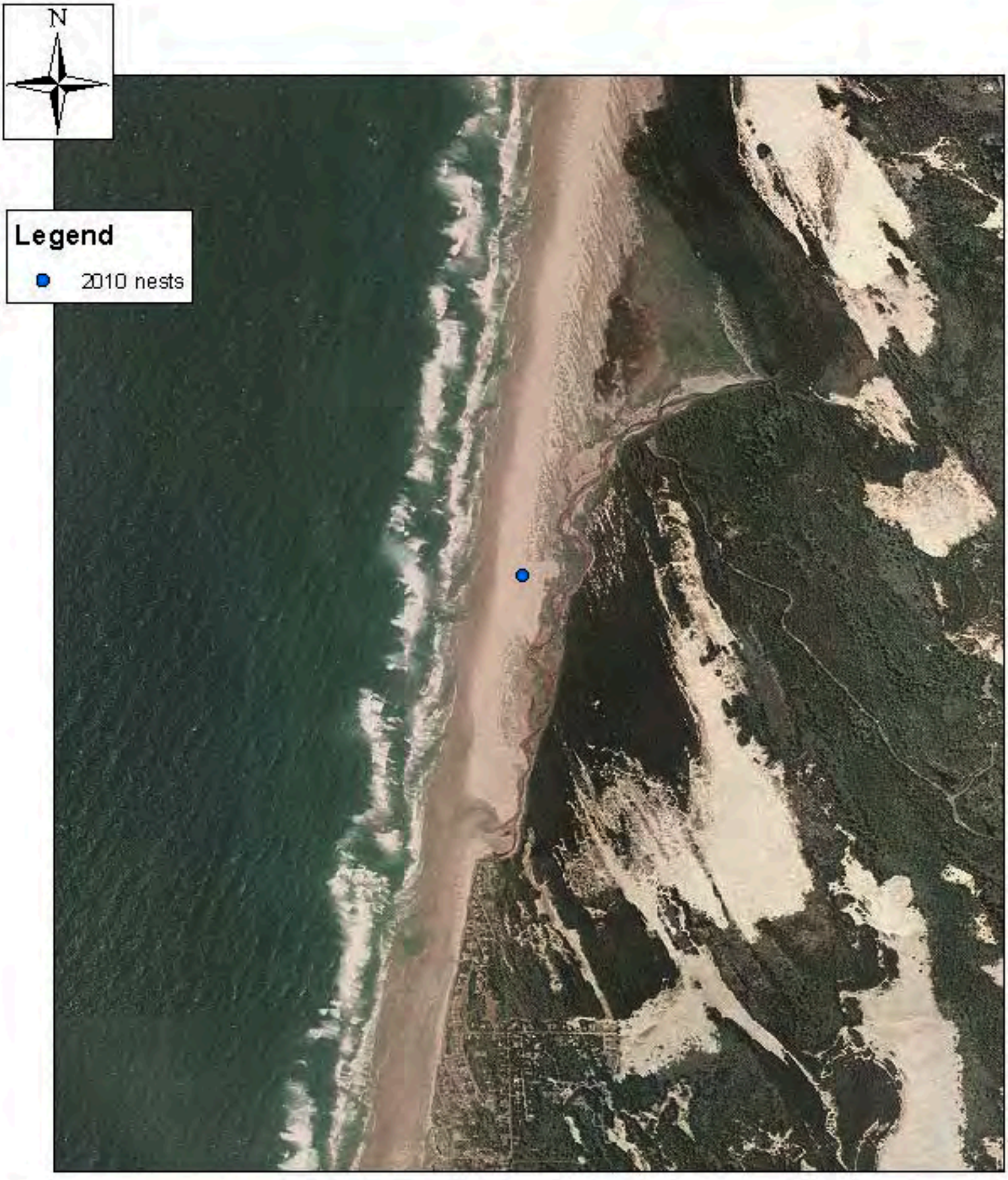


Figure 2. Snowy Plover nest locations at Sutton Beach, Oregon, 2010.

Figure 3. Snowy Plover nest locations at Siltcoos Beach, Oregon, 2010.

Figure 4. Snowy Plover nest locations at Dunes Overlook, Oregon, 2010.

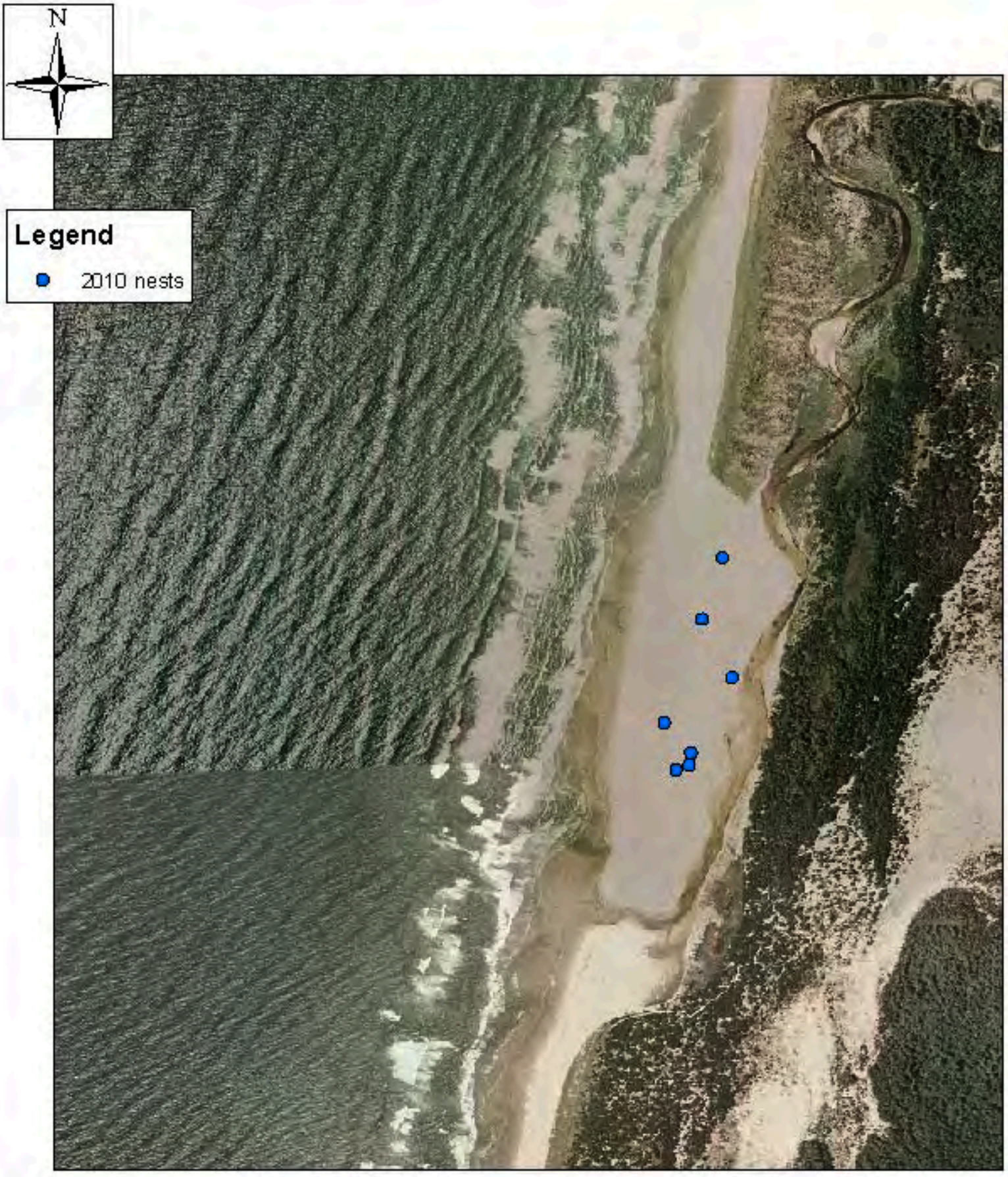


Figure 5. Snowy Plover nest locations at Tahkenitch Spit, Oregon, 2010.

Figure 6. Snowy Plover nest locations at Tenmile Spit, Oregon, 2010.

Figure 7. Snowy Plover nest locations at Coos Bay North Spit, Oregon, 2010.

Figure 8. Snowy Plover nest locations
at Bandon State Natural Area, Oregon, 2010.

Figure 9. Snowy Plover nest locations at New River, Oregon, 2010.

Figure 10. Number of active Snowy Plover nests within 10-day intervals on the Oregon coast, 2010. Dashed lines represent +/- 2 standard deviations.

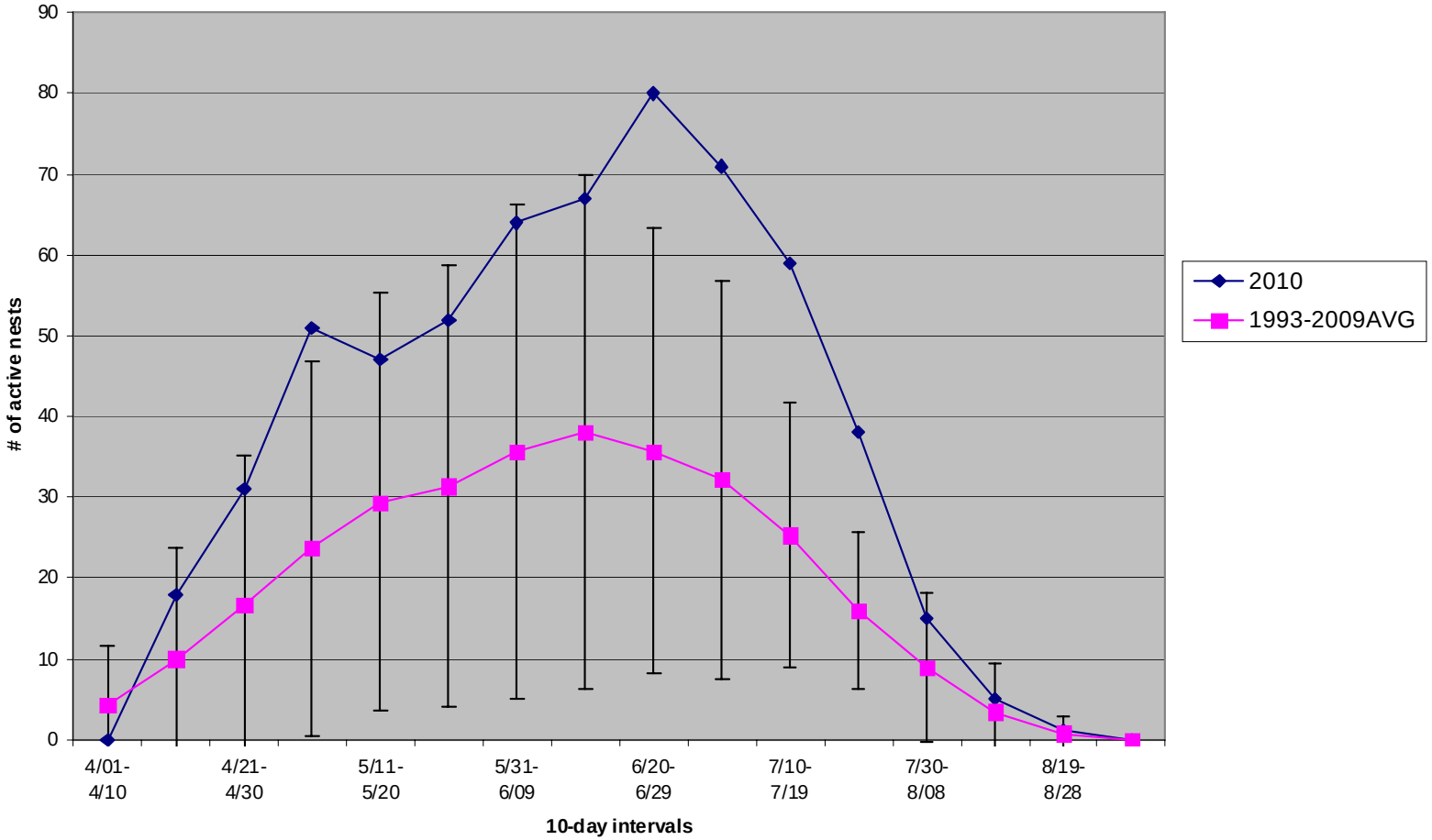


Figure 11. The number of exclosed and unexclosed days of Snowy Plover nests along the Oregon coast, 1992 – 2010.

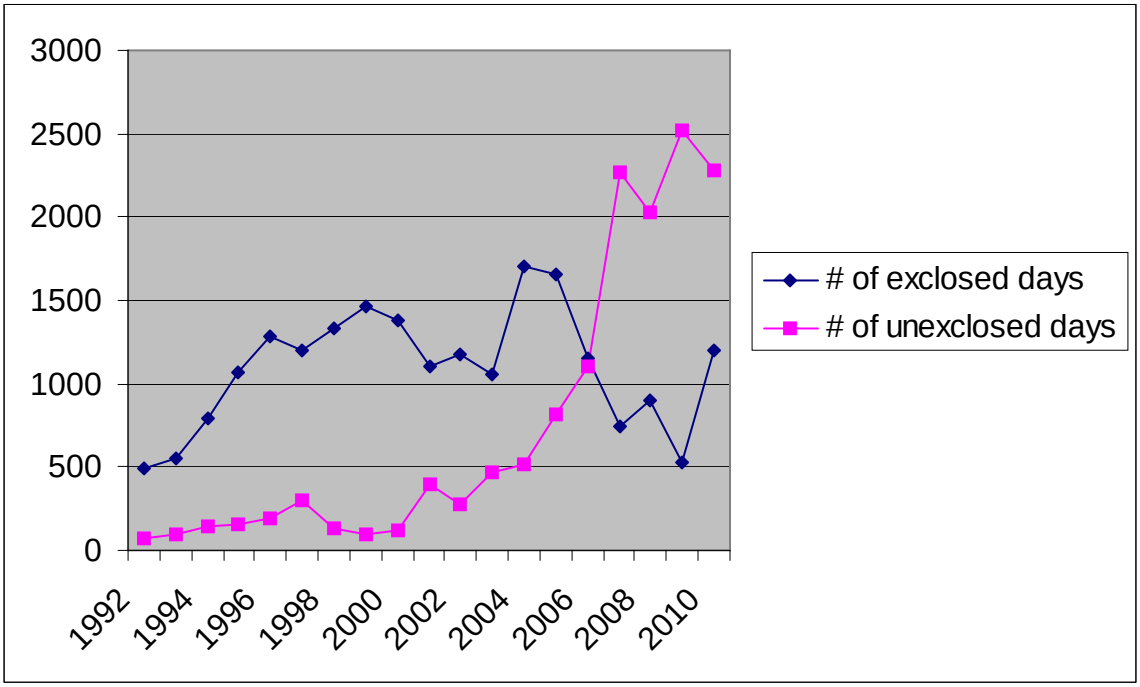


Figure 12. Mean percent nest success for Snowy Plovers along the Oregon coast, 1990-2010, with standard error bars. Number above each bar is the sample size.

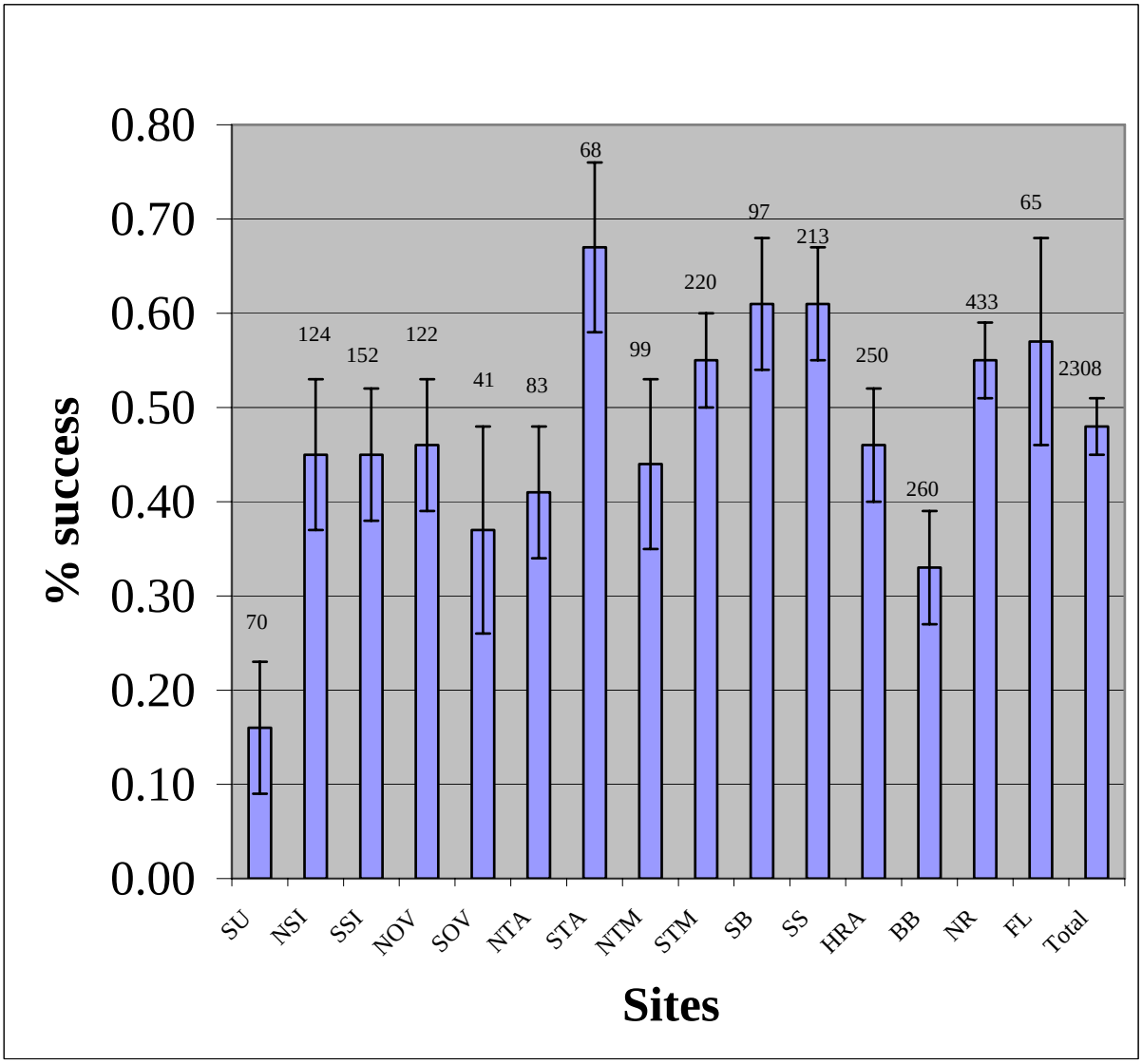


Figure 13. The mean fledging success rate of Snowy Plover along the Oregon coast before and after implementation of lethal predator management. Data pooled from Siltcoos to New River; before = 1992 – 2001, after = 2004 – 2010, 2002 and 2003 not included because some sites had predator management, and some did not. Error bars are standard error.

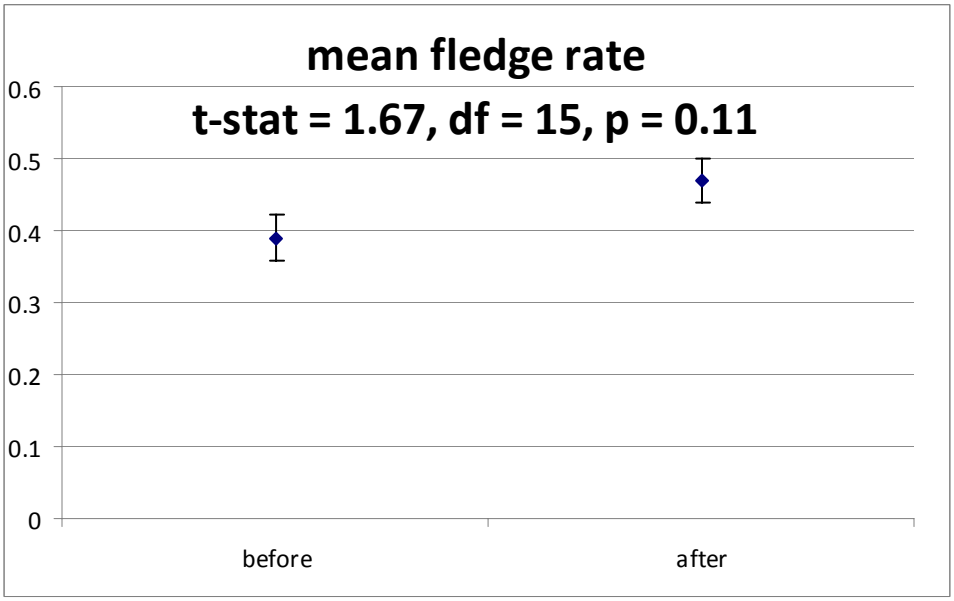
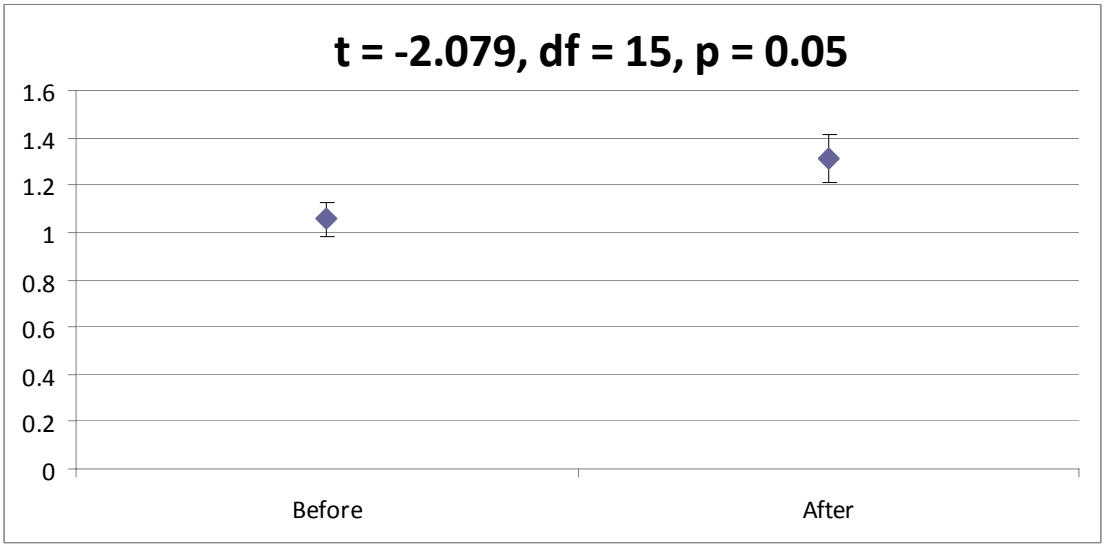


Figure 14. The mean number of fledglings per male for Snowy Plover along the Oregon coast before and after implementation of lethal predator management. Data pooled from Siltcoos to New River; before = 1992 – 2001, after = 2004 – 2010, 2002 and 2003 not included because some sites had predator management, and some did not. Error bars are standard error.



APPENDIX A. Study Area

The study area encompassed known nesting areas along the Oregon coast including all sites between Berry Creek, Lane Co., and Floras Lake, Curry Co. (Fig. 1). Survey effort was concentrated at the following sites, listed from north to south:

Sutton Beach, Lane Co. (Figure 2). - the beach north of Berry Creek south to the mouth of Sutton Creek.

Siltcoos: North Siltcoos, Lane Co. (Figure 3). - the north spit, beach, and open sand areas between Siltcoos River mouth and the parking lot entrance at the end of the paved road on the north side of the Siltcoos River; and South Siltcoos, Lane Co. - the south spit, beach, and open sand areas between Siltcoos River mouth and south to Carter Lake trail beach entrance.

Dunes Overlook Clearing, Douglas Co. (Figure 4). - the north and south areas cleared of beachgrass, beginning in 1998, directly west of the Oregon Dunes Overlook off of Hwy 101.

Tahkenitch Creek to the Umpqua River, Douglas Co. (Figure 5) - Tahkenitch North Spit - the spit and beach on the north side of Tahkenitch Creek; there was no habitat on the south side of Tahkenitch Creek due to erosion and the movement of the mouth of the creek.

Tenmile: North Tenmile, Coos and Douglas Cos. (Figure 6) - the spit and ocean beach north of Tenmile Creek, north to the Umpqua River jetty; and South Tenmile, Coos Co. - the south spit, beach, and estuary areas within the Tenmile Estuary vehicle closure, and continuing south of the closure for approximately 1/2 mile.

Coos Bay North Spit (CBNS), Coos Co. (Figure 7): South Beach - the beach between the north jetty and the F.A.A. towers; and South Spoil/HRAs - the south dredge spoil and adjacent habitat restoration areas (94HRA, 95HRA, 98HRA);

Bandon Beach, Coos Co. (Figure 8): the beach between China Creek and the location of the New River/Twomile Creek mouth, including the large habitat restoration area north of the mouth of Twomile Creek.

New River Spit, Coos Co. (Figure 9) - the beach and sand spit on the south side of the location of the mouth of New River/Twomile Creek, and the oceanside beach, overwashes and riverside deltas between the open spit and south to BLM lands, and the habitat restoration area (HRA) adjacent to the BLM boat launch at the Storm Ranch ACEC.

Floras Lake, Curry Co. – the beach and overwash areas west of the confluence of Floras Creek and the beginning of New River, north to Hansen Breach.

The following additional areas were either surveyed in early spring or the breeding window survey: Fort Stevens, Necanicum Spit, Nehalem Spit, Bayocean Spit, Netarts Spit, Sand Lake Spit, Nestucca River Spit, Whiskey Run to the Coquille River, Elk River, Euchre Creek, and Pistol River.

APPENDIX B. Recommendations for Management of Recreational Activities and Habitat Restoration for sites with Snowy Plovers along the Oregon Coast - 2010.

Sutton:

- Continue to manage the nesting areas particularly at the Sutton Beach HRA; consider spreading shell hash or woody debris to improve the nesting substrate.
- Continue predator management when and if plovers are nesting to reduce predation pressure on broods, particularly corvids.
- Rope and sign dry sand from Sutton Creek north to Baker Beach access, particularly if plovers are present.
- Continue to sign the backside of the foredune in order to minimize pedestrian crossing of dry sand.
- Place signs on the south side of Sutton Creek notifying people that if they cross the creek dogs must be on leash at all times.

Siltcoos North and South Spits:

- Continue predator management to reduce the number of corvids using the nesting area. Continue to reduce the feral cat population in the area. Continue to monitor and possibly remove coyotes that are using and possibly denning near the nesting area.
- Continue signage along river, especially east of nesting area and on any "islands" that may develop to alert kayak/canoe users about plover management activities.
- Continue to post the area with updated maps of the estuary and beach at several locations. These areas include the Stagecoach Trailhead, the north parking lot, and both ends of the Waxmyrtle Trail.
- Erect ropes and signs prior to 15 March, to be as effective as possible. Place signs and ropes on east and south side of the north spit nesting area as well as continued signage to the west and north.
- Continue to prohibit dogs on the spits and near the estuary during nesting season.
- Continue the use of campground plover hosts/volunteers to educate people and keep them out of closed areas. Use hosts/volunteers, especially during peak periods on weekends, and stagger their hours to cover evenings. Have hosts/volunteers in contact with Law Enforcement Officers to improve enforcement of the closures, and have them engage people on the beach before violations occur.
- Continue to extend appropriate signing to both riverbanks, to prevent hikers from walking up the closed estuary.
- Consider ropes and signs along the foredune south of Waxmyrtle trail access to the Carter Lake trail area; monitor this area for roosting, nesting and brooding plovers.

Overlook:

- Continue predator management to control corvid use of the area. Monitor Northern Harrier and Great Horned Owl use of the area and consider removal if harriers and owls continue to pose problems to breeding plovers.
- Continue to rope and sign both north and south closures for Snowy Plover nesting habitat by 15 March.
- Continue to improve and enlarge the restoration area, especially to the south towards Tahkenitch.
- Erect and maintain interpretive signing at the beginning of the Overlook trailhead (near viewing platforms). This signing is intended to provide more information on the ecology of the Snowy Plover and the reasoning for current management techniques and restricted areas.

- Continue to restrict all dogs to leashes adjacent to the Overlook nesting areas. It should be noted that many hikers with dogs are compliant while on-trail but often unleash their animals upon reaching the beach, therefore additional signing for clarification is highly recommended.

Tahkenitch:

- Continue to maintain and improve the habitat.
- Continue predator management to control corvid use of the area. Identify if Great Horned Owls or other avian predators are hunting the area. Remove if necessary.
- Continue to rope and sign all suitable habitat. Place signs along east and south edge outside of the roped area to prevent hiking and camping near nesting area.
- Continue to restrict dogs to leashes adjacent to closure areas.

Tenmile North and South Spits:

- Continue predator management to control corvid use of the area; continue to monitor coyote use and possibly remove coyotes if warranted. Monitor and remove Great Horned Owls if necessary. Evaluate rodent populations and depredations.
- Continue to maintain and improve the south side for nesting. Consider expanding and improving habitat on the north side.
- Continue to rope and sign plover nesting habitat on both north and south spits.
- Enforce vehicle closure to prevent violators from driving in the habitat restoration areas.

Coos Bay North Spit:

- Continue predator management of the area for corvids, feral cats, and skunks; monitor the coyote population and remove coyotes if warranted; improve efforts to reduce rodent depredations on plover nests.
- Continue to improve and maintain the habitat restoration areas. Continue to spread shell hash to improve nesting substrate.
- Maintain gaps in the berm along the 95HRA to facilitate brood movement from the 94HRA and 98WHRA to the 95HRA and to the beach. Maintain small vegetation free gaps in the foredune to facilitate brood access to the beach without destabilizing the foredune.
- Continue to rope and sign the beach as early in the nesting season as possible; avoid erecting signs where the ocean is repeatedly lapping against the foredune to reduce sign loss.
- Clearly sign all entrance points on the spit that the beach is street legal vehicles only.
- The seasonal reroute of the foredune road continues to benefit plovers by reducing recreational activity, and thus disturbance, near the nesting area, and permits brood movements between the HRA's without any chance of harm from vehicle use. A permanent reroute of the foredune road would be ideal.

Bandon:

- Continue predator management to control mammal and corvid populations.
- Continue to improve and maintain the habitat restoration area north of Twomile Creek. Improve habitat along the foredune to increase available nesting habitat for plovers.
- Sign and rope the entire beach from China Creek overwash to the habitat management area near to the mouth of Twomile Creek/New River before the nesting season.
- Maintain enforcement of restricted areas and leash laws for dogs. Monitor hiker use from Bandon to Blacklock Point, and check the beach and HRA on weekends for illegal camping activity.

New River:

- Continue predator management to control mammal and corvid populations.
- Continue to improve and maintain the habitat restoration area.
- Sign the foredune north of the HRA along the foredune.
- Place interpretive signs near the Lower Fourmile access along the river to inform the public of plover activity.
- Sign State Parks lands on the open spit south of the mouth of New River. Enforce dogs on leash rules. Consider use of an interpretive specialist to help monitor recreational activities in the area and explain the management efforts in the area.
- Continue to close the gate at the Storm Ranch for 15 April- 15 September.

Floras Lake:

- Monitor the site for any plover activity.
- Enforce dogs on leash rules at all times.
- Continue to hire an on-site interpretive specialist, to contact the public, monitor the beach, and present slide shows.